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PRACTICAL
PHARMACY AND PRESCRIBING.



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PRACTICAL
PHARMACY AND PRESCRIBING
FOR
STUDENTS OF MEDICINE

BEING THE COURSE IN USE AT ST. BARTHOLOMEW'S
HOSPITAL

BY

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PREFACE TO THE SECOND EDITION.

THE first part of this practical course is meant to be a preparation for the second part. In expanding the second part I have found especially useful Ruddiman's *Incompatibilities in Prescriptions*, Scoville's *The Art of Compounding* (both of these are American books) and *The Art of Dispensing*.

The chief hindrance to independent prescribing is the fear of committing a bad incompatibility. A student may know quite well the drugs he should give in any particular case, but he is afraid of putting them together, except in some combination copied from his Hospital Pharmacopœia, or from some other book full of ready-made prescriptions. Therefore the art of prescribing resolves itself very largely into the knowledge of incompatibilities.

The object of this practical course is to supply in some degree the knowledge of incompatibilities.

The ordinary dispensing should be done in the Hospital Dispensary or elsewhere.

PREFACE TO FIRST EDITION.

THE basis of the first part of this practical course was given to me by Sir Lauder Brunton when I became his demonstrator some years ago.

I am also much indebted to the works of Proctor, Elborne, and Lucas on Practical Pharmacy, to that excellent book *The Art of Dispensing*, and to Mr. Moore, the Head of the Hospital Dispensary.

The part dealing with Prescriptions and Incompatibles is the beginning of an attempt to interest men, just before they enter the wards, and whilst their chemistry is still fresh, in a subject of much practical importance, and which they can cultivate during the whole period of their clinical training, so that when they pass into practice they may not be absolutely chained to the formulæ of the Hospital Pharmacopœia, or to the tabloids of the manufacturing chemists.

At the end of each class a demonstration is given for half an hour on materia medica specimens, preparations, doses, and so forth.



PRACTICAL PHARMACY.

Apparatus required.—*The following articles should be always ready for each student:—Twelve test-tubes, with stand. Test-tube holder. Test-tube brush. Bunsen's burner or spirit lamp. Towel or duster.*

I.

Apparatus required.—Scales and weights. Spatula. White paper. Small mortar. Shot. 4-oz. measure. Minim measure. Minim pipette. Domestic measures.

Introduction: Explanation of Pharmacy and Pharmacopœias.

Quantities and their measurement.

Explanation of weights and measures—English, French, Domestic.

Drugs required.—*Powders:* Powdered sugar or milk sugar, or starch or zinc oxide afford examples of medium, light, and heavy powders. Different powders may be given to adjoining students. Strychnine in powder. *Liquids:* Water. Alcohol. Glycerin.

Weighing and Subdivision.

Of Solids.—Weigh out 30 grs. of the powder. Put the weighed powder on a piece of white paper; with a spatula divide it into three parts, as nearly equal as you

can make them. Weigh two of them, so as to see how near to an equal division you have made, and from the weight of these two calculate the weight of the third.

Of Small Quantities of Powerful Drugs.—If it is necessary to weigh out fractions of a grain and the scales will not weigh accurately less than a grain, the drug may be diluted with some inert powder and the proper proportion of the mixture weighed out. For example, in order to weigh out a $\frac{1}{40}$ grain of strychnine, weigh out very carefully 1 gr. Throw it into a small mortar. Weigh out 39 grs. of powdered sugar of milk, put it in the mortar, and mix thoroughly with a spatula. Weigh out 1 gr. of the mixture. It will contain $\frac{1}{40}$ grain of strychnine.

See *Pulvis Elaterini Co.*, in which the sugar of milk is added to bring the dose within the weighing capacity of the ordinary dispensing scales.

Of Liquids.—Put a small bottle into one pan of the scales. Counterbalance it with small shot. Put into the opposite scale a weight (*e.g.*, 60 grs.). Pour liquid into the bottle till the weight is exactly counterbalanced.

Measuring.

Measure out 1 oz. of the liquid supplied.

Measure 20 minims " "

Measure 3 minims " "

Fill a tablespoon with liquid, and ascertain the amount it contains by measuring it in a glass measure.

Repeat this with a dessertspoon.

" " teaspoon.

Drop out of the bottle 20 drops of each liquid supplied into a minim measure, and note the number of minims to which the 20 drops correspond.

Read from the lowest level of the meniscus.

II.

Apparatus required.—Pestle and mortar. Beaker. Sieves. Elutriating jar. Test-tubes.

Drugs required.—Squill bulb. Dried squill. Quassia wood. Lump of chalk. Camphor. Spirit. Ipecacuanha. Potassium sulphate. Mercury. Sulphur. Prepared chalk. Solution of stannous chloride. Milk sugar. Bismuth sub-nitrate. Powdered gum-acacia. Powdered gum-tragacanth. Cinnamon water. Syrup.

Preparation of Drugs.

EXAMPLES OF MECHANICAL SUBDIVISION.

Cutting.—Squill. Quassia.

Rasping.—Quassia.

Pounding, trituration.—Pound a piece of chalk. Triturate it. Fold the powder in a paper, and preserve for use presently.

AIDS TO SUBDIVISION.

Drying.—Try to pound { α . Some moist squill.
 { β . Some dry squill.

Nux vomica beans are so tough that, before they can be successfully pounded they must be steamed until they have swelled to about twice their size; they are then rapidly dried at 200° F.

(After Class visit Dispensary and see Drying Chamber).

Moistening.—Try to pound a piece of camphor. Moisten with spirit, and pound again.

Addition of Other Substances :—

(α) Try to pound a piece of ipecacuanha. Add to it some potassium sulphate or milk sugar, and try again.

(See Pulv. Ipecac. Co. B.P. and U.S.P.).

(β) Triturate some mercury (*a*) alone, (*b*) with sulphur.

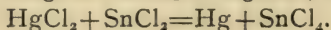
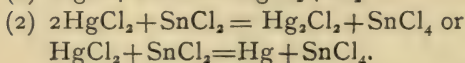
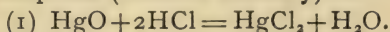
(See Empl. Hydrargyri and Empl. Ammoniaci & Hydrarg.).

(γ) Triturate some mercury with prepared chalk. The mercury in Hydrargyrum & Cretâ being finely divided may become partly oxidised and thus contain mercuric oxide as an impurity. Mercuric oxide in the stomach would form, with the acid of the gastric juice, mercuric chloride, and this is a powerful poison.

The gastric juice has no action on metallic mercury.

Experiment.—To the specimen supplied add dilute hydrochloric acid, heat gently and filter. $\text{Hg} + \text{CaCO}_3 + 2\text{HCl} = \text{Hg} + \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$.

The filtrate containing CaCl_2 will give no precipitate with stannous chloride. But if mercuric oxide be present the filtrate will contain HgCl_2 and stannous chloride solution will give a white precipitate (Hg_2Cl_2) or a grey precipitate (metallic mercury) :—



SEPARATION OF COARSE AND FINE POWDERS.

Place the chalk already pounded in a beaker. Shake, and notice that the coarser particles come to the top.

Sieves and Sifting.

Note the sizes of the meshes in the sieves shown you. Different degrees of coarseness or fineness of powders

of drugs are distinguished in the B.P. by numbers such as No. 20, No. 60. (Explanation).

ELUTRIATION.

Preparation of Creta Præparata.

Put some pounded chalk into a jar. Pour water on it, and shake. Observe that the larger particles fall to the bottom instead of coming to the top, as when the dry powder was shaken.

Pour off the liquid at the top into another glass, and allow the particles to subside. Notice their fineness as compared with that of the original powder.

SUSPENSION.

Take three test-tubes. Into each put about 10 grs. of bismuth subnitrate. Add to this in tube 1 an equal quantity of powdered gum-acacia. To tube 2 add the same quantity of tragacanth powder. Fill all three with water, and shake. Notice that the powder remains longer in suspension in the tube which contains the powdered acacia than in the water alone, and remains longest in suspension in that containing the tragacanth powder.

Preparation of Mistura Cretæ.

Weigh out 1 dr. of prepared chalk; 7 grs. of powdered tragacanth and 2 drs. refined sugar; measure out 4 ozs. of cinnamon water; put the chalk and tragacanth and sugar into a mortar and rub them up together; gradually add the cinnamon water; continue the rubbing until the whole is well mixed; pour it into a bottle and shake.

III.

EXAMPLES OF MECHANICAL SUBDIVISION (*continued*).

Apparatus required.—Scales and weights. Glass measures.
Pestles and mortars. Test-tubes.

Drugs required.—Olive oil. Almond oil. Mucilage.
Starch or starch paste. White of egg. Soap or an
alcoholic solution of it. Solution of prepared bile.
Tincture of quillaia. Liquor Potassæ. Lime water,
ammonia, oil of turpentine, balsam of copaiba.

EMULSION*—OF FIXED OILS.

Fill a test-tube about one-third full of water, and put into it a few drops of oil; shake it up, and notice that the oil separates rapidly and rises to the top.

Add to the water about 1 fl. dr. of mucilage and shake again; notice that the oil breaks up into small globules and remains suspended. (*Note* Haustus Olei Morrhuæ, St. B. H. P.).

Repeat this, using about $\frac{1}{2}$ dr. of starch paste instead of mucilage.

Repeat this, using a little white of egg instead of mucilage.

Repeat this, using a few drops of soap solution instead of mucilage.

Repeat this, using a few drops of bile solution instead of mucilage. (Physiological use—cod-liver oil).

Repeat this, using a few drops of tincture of quillaia instead of mucilage.

* The term "Emulsion" is generally restricted to mixtures of water thickened by mucilage or some other appropriate substance, and an oil or an oleo-resin in a condition of fine subdivision. Sometimes the term is used to include resins similarly suspended, *e.g.*, Mist. Guaiaci, Mist. Ammoniaci.

Repeat this, using about a drachm of solution of potash.

Explanation of the action of potash. Similar action of other alkaline solutions.

Preparation of Linimentum Calcis.

Mix equal parts of olive oil and lime water in a test-tube, and shake them together.

Preparation of Linimentum Ammoniaë.

Put 2 parts of olive oil, 1 part of almond oil, and 1 of liquor ammonia into a test-tube, and shake them together.

See *Preparation of Linimentum Hydrargyri and of Mistura Olei Ricini.*

EMULSION—OF VOLATILE OILS AND OLEO-RESINS.

Fill a test-tube one-third full of water; add to it a few drops of oil of turpentine, and shake together; the oil of turpentine separates into small drops, but does not remain subdivided.

Repeat this, using starch mucilage (*see* p. 31) instead of water. An emulsion is formed (*Enema Terebinthinæ*).

Repeat this, using a few drops of soap solution. An emulsion is again formed.

Repeat this, using a few drops of copaiba instead of oil of turpentine. The copaiba floats in large globules, but when a few drops of *Liquor Potassæ* are added to the water, an emulsion is formed. (Explanation).

Preparation of Linimentum Terebinthinæ.

Put into a mortar 10 grs. of soft soap, and add to it 30 minims of distilled water; put 80 minims of oil of

turpentine, and 5 grs. of camphor into a test-tube; shake them together, and add the mixture to the soap, rubbing until a fine emulsion is formed.

IV.

Apparatus required.—Test-tubes. Pestle and mortar.

Drugs required.—Potassium Permanganate. Camphor. Alcohol. Carbolic acid. Chloroform. Chloral hydrate. Liquor Calcis. Paraldehyde.

Examples of Solution.

Common solvents are:—Water, alcohol, ether, glycerin.

Solution of Solids in Liquids.

Water is the most universal solvent. As a rule water is the best solvent for inorganic, and alcohol for organic substances. This rule is not invariable; sugar is a striking exception.

Experiment.—Take four test-tubes. Into each of two put a crystal of permanganate of potash. Put water into one and alcohol into the other. Shake, and the permanganate will be seen to dissolve readily in the water (*see* Liquor Potassii Permanganatis) and sparingly in the alcohol, as evidenced by the colour.

Into each of the other two test-tubes put a small piece of camphor, and repeat the experiment. The camphor will dissolve very sparingly, though to some extent in the water (*see* Aqua Camphoræ), and readily in the spirit (*see* Spiritus Camphoræ).

Note.—For the usual method of preparing the Aquæ of the B.P.. see p. 23.

(Demonstration of Acidum Carbolicum Liquefactum).

Solution of a Liquid in a Liquid.

Experiment.—Allow a drop or two of chloroform to fall into some water in a test-tube. Shake it, and allow the chloroform to subside. Taste the water, and it will be found to be sweet (*see* Aqua Chloroformi).

Repeat this with spirit. The chloroform will dissolve more readily (*see* Spiritus Chloroformi).

Solution of a Gas in a Liquid.

See Liquor Ammoniaë Fortis, B.P.

Union of Two Solids to form a Liquid.

Experiment.—Rub together in a mortar a piece of camphor and a few crystals of chloral hydrate. They unite to form a syrupy liquid.

Note.—Chloral hydrate acts similarly with menthol and thymol, and several other solids.

Phenol, when rubbed up with them, forms a liquid with many solid substances.

Effect of Subdivision on Solution.

Substances dissolve as a rule more and more quickly the larger the area exposed to the action of the solvent.

Effect of Saturation on Solution.

Substances dissolve more and more quickly the less the layer of solvent surrounding them approaches saturation.

Agitation aids solution.

Percolation aids solution, *see* Tinctures, page 47.

Effect of Temperature on Solution.

Heat aids solution.

Exceptions—Lime salts. Heat lime water, and a deposit will form. Explain preparation of tartaric and citric acids.

Paraldehydum is less soluble in hot than in cold water.

V.**Examples of Solution** (*continued*).

EFFECT OF THE ADDITION OF OTHER SUBSTANCES.

Apparatus required.—Pestle and mortar. Flasks. Test-tubes.

Drugs required.—Acid. Carbol. Liq. Liq. Calcis Sacch. Arsenious acid. Potassium carbonate. Compound tincture of lavender. Hydrochloric acid. Iodine. Potassium iodide. Alcohol. Mercuric iodide. Sodium salicylate. Caffeine. Tin tacks. Nitric acid. Yellow and red prussiate of potash. Quinine sulphate. Sulphuric acid. Acid hydrochloride of quinine. Potassium bitartrate. Liquor Potassæ.

Sugar.

Cane sugar added to certain oxides forms soluble salts called saccharates or saccharosates.

They must be distinguished from the salts of saccharic acid.

Demonstration: Liquor Calcis— $\frac{1}{2}$ gr. of lime in an ounce of water and Liquor Calcis Saccharatus—8 grs. of lime in an ounce of water.

Liquor Calcis Saccharatus, diluted with water, is used as an antidote in carbolic acid poisoning. The lime precipitates the phenol.

Experiment:—Add to a few drops of Acid. Carbol. Liq., in an ounce of water, some Liq. Calc. Sacch.:—white precipitate.

Potassium Carbonate to Arsenic.

Preparation of Liquor Arsenicalis. Take of—

Arsenious acid in powder	} of each	... gr. xj.
Carbonate of potash		
Compound tincture of lavender	...	℥xxxviij.
Distilled water	... ..	q. s.

Place the arsenious acid and the carbonate of potash in a flask with $1\frac{1}{4}$ ozs. of water, and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender and as much distilled water as will make the bulk to 3xx. (Remember the alkalinity and the red colour of Liq. Arsenicalis, but do not attempt to remember any of the above quantities).

Hydrochloric Acid to Arsenic.

Preparation of Liquor Arsenici Hydrochloricus. Take of—

Arsenious acid in powder	... ..	gr. xj.
Hydrochloric acid	... ..	mxxv.
Distilled water ..	... ..	a sufficiency.

Boil the arsenious acid with the hydrochloric acid and 4 drachms of water until it is dissolved; then add distilled water to make the bulk to 3xx.

Iodide of Potassium to Iodine.

Into each of two test-tubes put a crystal of iodine, and fill up to one-third with water. Drop into one of them a crystal of iodide of potassium. The iodine will dissolve.

Repeat this with alcohol (*see* Tinctura Iodi and Liquor Iodi Fortis).

Iodide of Potassium to Metallic Iodides.

Put about a fluid drachm of water into a test-tube. Drop into it about 5 grs. of mercuric iodide, and shake. It will not dissolve. Drop into it a crystal of potassium iodide and it will readily dissolve. (A soluble double salt is formed, *see* Haustus Hydrarg. Perchlor. & Pot. Iod. St. B. H. Ph.).

Sodium Salicylate to Caffeine.

Caffeine is sparingly soluble in water but it is freely soluble in watery solution of sodium salicylate.

Advantage is taken of this fact to obtain a concentrated and unirritating solution of caffeine, for use hypodermically as a respiratory and cardiac stimulant, *e.g.*, in alcoholic or morphine poisoning.

Take $17\frac{1}{2}$ grs. of sodium salicylate and dissolve in 1 drachm of water, add gradually 20 grs. of caffeine (= 1 gr. in 3 minims. Dose for hypodermic injection 1 to 6 minims).

Compare the action of sodium salicylate with the *citrate* of caffeine in a mixture (*see* page 99).

Solution in Acid.

Preparation of Liquor Ferri Persulphatis.—Put about a drachm of diluted sulphuric acid into a test-tube. Drop into it a clean tin tack and heat. The iron will dissolve with effervescence. Test the solution with yellow and red prussiate of potash. It will give a very light blue with the former, and a dark blue with the latter. Add about 20 drops of nitric acid, and boil. Test again, and the solution will now give a dark blue

with yellow prussiate, and, if it has been long enough boiled, no precipitate with red prussiate. (Ferrous oxidised to ferric sulphate).

Note regarding *Liquor Ferri Perchloridi* and *Liquor Ferri Pernitratis*.

Solution in Acid without Decomposition, but with Formation of Acid Salt.

Put a small quantity of quinine sulphate in a test-tube with water, and shake. The quinine sulphate hardly dissolves at all. Add a few drops of dilute sulphuric acid, and solution occurs at once. Note the fluorescence—a solution of quinine in an acid will be fluorescent if the acid be one containing oxygen.

Demonstrate the ready solubility in water of *Quininæ Hydrochloridum Acidum*, and note that the solution is not fluorescent.

Solution in Alkali with Production of Neutral Salt.

The acid tartrate of potassium (cream of tartar) is very sparingly soluble in water—the neutral tartrate is freely soluble.

Put into two test-tubes a few grains of potassium bitartrate. Fill each tube about one-third with water. To one add about $\frac{1}{3}$ dr. of *Liquor Potassæ*. Shake, and the crystals will dissolve quicker in the alkaline solution.

VI.

Examples of solution (*continued*).

ALCOHOL.—Varieties:—There are six varieties of alcohol recognised in the B.P. as solvents. They all

differ from each other in the proportion of alcohol they contain. On this account they also differ in their solvent power.

(i) *Absolute*, contains not more than 1 per cent. of water. Sp. gr. about .795.

Anhydrous copper sulphate should not become coloured in contact with pure alcohol.

Experiment.—Test for water in absolute alcohol. Put a crystal of copper sulphate in a porcelain dish and drive off the water of crystallization. The blue crystal becomes colourless. Now add to it—(1) Some absolute alcohol. (2) Some dilute alcohol.

(ii) *Rectified spirit*, which contains 10 per cent. of water. Used in the preparation of tinctures, spirits, liniments, &c.

(iii) from *Rectified spirit*, by diluting with distilled water are prepared alcohols of 75, 60, 45, and 20 per cent. Used as solvents of principles, soluble partly in water and partly in alcohol.

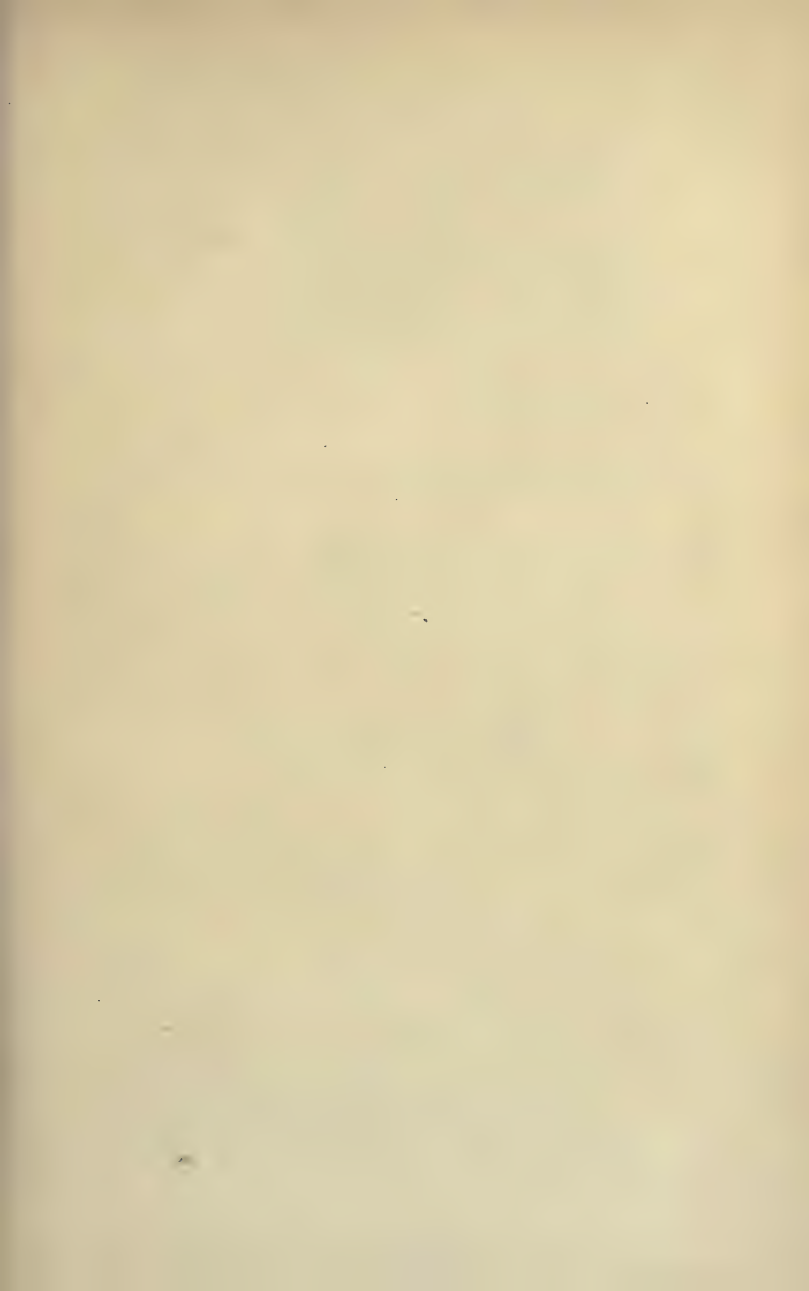
Sp. Vini Gallici (brandy) and Vinum Xericum (sherry) differ from the others not only in the proportion of alcohol, but in containing volatile flavouring substances. All the Vina of the B.P. except two are made with sherry.

ALCOHOL AS A SOLVENT.

Alcohol dissolves inorganic bodies, as a rule, less readily than water.

Alcohol dissolves organic bodies, as a rule, more readily than water.

Thus alcohol dissolves crystalline inorganic substances like potassium iodide, or ferric sulphate, sparingly, if at all, but dissolves bodies of the alcoholic series, such as





chloroform, iodoform, paraffin; also *volatile oils*, *fixed oils*, *fats*, *resins* and *alkaloids*.

Gummy and albuminous matters are soluble in water and insoluble in alcohol.

Experiments.—Put a few grains of iodoform into each of two test-tubes; add about 1 dr. water to one and a similar quantity of alcohol to the other, and shake. The iodoform hardly dissolves in the water, but in the alcohol it dissolves.

Repeat this with a few drops of chloroform (*see Spiritus Chloroformi*).

Repeat this with a piece of paraffin the size of a small pea.

Repeat this with a piece of camphor (*see Spiritus Camphoræ*) the size of a small pea.

Repeat this with a drop of oil of peppermint.

Repeat this with a piece of lard.

Repeat this with a piece of resin or jalap resin or podophyllin resin.

Repeat this with a crystal of strychnine.

Repeat this with some gum acacia.

Warmth may be used to quicken the solution of the above substances.

Spirits, Tinctures, Vina, &c., preparations in which alcohol is the solvent (*see Chapter XIV.*).

CHLOROFORM AS A SOLVENT.

It dissolves all the substances above mentioned as soluble in alcohol.

It dissolves alkaloids very easily.

Compare the solubility of a crystal of strychnine in chloroform with that just noted under alcohol.

Linimentum Chloroformi.—Mix equal parts of camphor liniment (*vide infra*) and of chloroform.

Chloroform contains about 1 per cent. absolute alcohol to prevent decomposition on keeping.

Chloroform is often added to prescriptions, generally in the form of *Spiritus Chloroformi*. It is antiseptic, so that its presence in a mixture is preservative as well as carminative, moreover it gives to the mixture a sweet agreeable taste.

GLYCERIN AS A SOLVENT.

It dissolves many substances and is contained in many pharmacopœial preparations, but it is used especially on account of its sticky nature to dissolve substances which we wish to apply for a prolonged time to the skin or mucous membrane.

Glycerinum Amyli.—Put 1 dr. starch into a porcelain dish with $1\frac{1}{2}$ drs. water and $6\frac{1}{2}$ drs. glycerin. Stir constantly, and heat till a clear jelly is formed.

Glycerinum Tragacanthæ.—Put 30 grs. tragacanth powder into a mortar. Add $1\frac{1}{2}$ drs. glycerin, and mix. Then add 30 minims distilled water, and rub till a homogeneous paste is produced.

The other seven Glycerina of the B.P. are fluids.

Glycerin being hygroscopic is often used, generally in the form of *Glycerinum Tragacanthæ*, as a pill excipient, to keep the pills soft.

Glycerinum Pepsini contains also hydrochloric acid, and has a dose (1 to 2 drs.). Glycerin is the best solvent and preservative of the peptic ferment.

(*Liq. pancreatis* is a solution in 20 per cent. alcohol, and has no dose. The proteolytic ferment at least is destroyed by the gastric juice. Pancreatic extract can,

however, be given in keratin capsules, keratin being insoluble in the gastric juice but soluble in the alkaline fluids of the small intestine).

Suppositoria Glycerini.—The necessary consistence is given by the addition of gelatin.

This is the only suppository which does not contain oil of theobroma.

The Lamellæ.—The gelatin is added to give the necessary consistence.

Glycerin is sometimes added to other substances to restrain or prevent chemical reaction,* *e.g.*, to a mixture where there is a tendency for substances in solution to form a precipitate, or to a pill, *e.g.*, *Pilula Ferri*, where no doubt the hygroscopic quality of glycerin is of use, but it also prevents, together with the syrup present, the oxidation of the ferrous carbonate to ferric. It is contained in *Tinctura Kino* to prevent the oxidation and consequent gelatinization which is due to the conversion of the tannic acid into a compound insoluble in alcohol.

It is contained in *Confectio Sulphuris* to keep the preparation moist, in *Lotio Nigra* to prevent the fabric on which the lotion may be applied becoming dry and adhesive, and in *Unguentum Acidi Carbolici* to dissolve the phenol which is insoluble in the Paraffin basis of the ointment.

ETHER AS A SOLVENT.

Extractum Strophanthi.—The powdered seeds are first treated with *Æther Purificatus*, and the ethereal extract of inert oil and resin thrown away. An alcoholic extract is then made, evaporated down, and mixed with

* Mucilage or Syrup is also used for the same purpose.

sugar of milk in order to make the dose suitable to an extract of this kind—viz., $\frac{1}{4}$ to 1 gr.

Purified ether must be used because the alcohol and water (8 per cent.) of ordinary ether would dissolve out some of the active principle.

Extractum Filicis Liquidum.—The powdered rhizome is percolated with ether and the percolate is distilled to get rid of the ether—the oil remaining contains the active principles and constitutes the liquid extract.

Collodium, Collodium Flexile, Collodium Vesicans (see p. 30).

Liquor Epispasticus.—Acetic ether is used because it readily dissolves the Cantharidin, and when applied to a surface rapidly evaporates.

Tinctura Lobeliæ Ætherea.—Spiritus Ætheris is used here less as a solvent than as a corrective to the depressant action of Lobelia on the heart.

FIXED OILS AS SOLVENTS.

Fixed oils dissolve volatile oils.

Some volatile oils are much used as carminatives, and being soluble in fixed oils they are often prescribed with cod-liver oil.

Preparation of Linimentum Camphoræ.—Put 2 drs. olive oil in a test-tube, and add 30 grs. camphor. Shake till the camphor is dissolved. (Compare preparation of Lin. Camph. Amm.).

VOLATILE OILS AS SOLVENTS.

Volatile oils dissolve some resins. Put a piece of resin the size of a pea into a test-tube and pour on a drachm of oil of turpentine, and shake. The resin will dissolve.

Repeat with resin of jalap. It will not dissolve.

ALKALIES AS SOLVENTS.

Pour off the oil of turpentine from the jalap resin and add some Liquor Potassæ. The jalap resin will dissolve. Add a few drops of solution of litmus to show the reaction, and then neutralise with hydrochloric acid. The resin will be precipitated as a fine powder.

Repeat this experiment with a piece of resin of guaiac and Liquor Ammonizæ (*see* Tinct. Guaiaci Amm.).

See also the preparation of Mistura Ferri Co. on page 26.

VII.

Apparatus required.—Test-tubes. Glass slides. Covering glass. Microscope. Evaporating basin. Sand-bath. Water-bath. Glass plate.

Drugs required.—Compound tincture of benzoin. Ammoniated tincture of quinine. Hydrochloric acid. Tincture of podophyllum. Methylated spirit. Bismuth. Nitric acid. Solution of chloride of antimony. Sodium carbonate.

Examples of Precipitation.

By withdrawal of the Solvent.—In evaporation the solvent is withdrawn by air, but it may also be withdrawn by admixture of the solution with other liquids in which the solvent is soluble, but the substance dissolved is not.

Put on a glass plate, slide, spatula, or spoon a drop of Tinct. Benzoini Co. and heat. The alcohol evaporates

into the air, and the benzoin and other solids contained in the Tincture are left. (Evaporation).

Put a few drops of the tincture into water in a test-tube, and the alcohol is dissolved by the water, but the resin is not, and it falls as a precipitate.

Repeat with a few drops of Tinct. Quin. Amm., which is a solution of the hydroxide of quinine in alcohol and excess of ammonia.

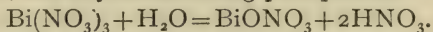
Preparation of Podophylli Resina.—Acidulate 3 fl. drs. of water in a test-tube by pouring into it mxxx. of hydrochloric acid. Pour in 1 fl. dr. of the tincture of podophyllum. Let the precipitated resin settle. (It should afterwards be washed in a filter with distilled water and dried on a stove).

In this experiment the alcohol in which the substance was dissolved has been withdrawn by water (in which it was insoluble). (Compare preparation of Jalapæ Resina).

Precipitation by Removal of Acid by Addition of Water.

Preparation of Subnitrate of Bismuth.—Mix 20 minims of nitric acid with three-quarters of its own bulk of water in a test-tube, and drop into it small pieces of bismuth. When effervescence has ceased, boil and pour off the clear liquid into a large beaker of water. (If time allowed, the excess of acid ought to be evaporated off before pouring into water, and the precipitate washed by decantation and dried).

The nitrate of bismuth $\text{Bi}(\text{NO}_3)_3$ is stable in presence of a certain amount of free HNO_3 . The boiling is to drive off some of this HNO_3 before throwing the nitrate into water, the oxynitrate being precipitated:—



Preparation of Oxide of Antimony.—Pour a few drops of solution of chloride of antimony into a beaker of water.

Carefully pour off the water from the precipitated oxy-chloride and decompose it by adding a few grains of sodium carbonate dissolved in water. (The precipitate ought then to be washed and dried).

VIII.

Apparatus required.—Test-tubes. Tripod. Wire gauze. Stirring rod. White tile, or glass plate with white paper. Calico filter. Glass plate. Jug or beaker. Crucible or iron spoon. Tripod or retort stand. Wire triangle. Fine iron wire.

Drugs required.—Quinine. Sulphuric acid. Liquor sodæ. Aqueous solution of litmus or tincture of litmus. Lime. Sublimed sulphur. Hydrochloric acid. Potassium carbonate. Chloral hydrate. Aniline. Calcium sulphate. Wood charcoal in powder. Dolomite.

Examples of Precipitation (*continued*).

Precipitation by Removal of an Acid by Addition of an Alkali.

Put a few grains of quinine into a test-tube, and dissolve in water with the aid of sulphuric acid. Add a few drops of solution of litmus, to show the reaction. Add now a solution of soda gradually. A precipitate will form, which redissolves on shaking, as long as the liquid is acid; but as the acid is neutralised and the liquid becomes blue, the precipitate becomes permanent.

Precipitation by Addition of an Acid.

Preparation of Precipitated Sulphur.—Put a few grains of lime and of sublimed sulphur into a test-tube with a little water. Boil for a few minutes, and allow the liquid to settle. Pour off the yellowish liquid into another test-tube, and add a few drops of hydrochloric acid. The liquid will become milky white. (Compare the effect of adding sulphuric acid).

Allow the precipitate to subside.

Washing.—Throw it on a calico filter, and wash with distilled water.

Drying.—Put it on a glass plate, and stand this on a jug of hot water.

Impurities of Precipitated Sulphur.

If imperfectly washed, so that the acid and calcium sulphide were not quite removed, it might have a smell of H_2S . (This it ought *not* to have).

If the cheaper *sulphuric acid* be used instead of *hydrochloric acid*, insoluble $CaSO_4$ will be formed, instead of the soluble $CaCl_2$, and it will be precipitated together with the sulphur.

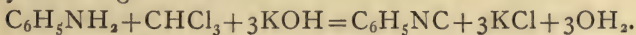
Thus precipitated sulphur may contain calcium sulphate as an impurity :—It should volatilize entirely if heated over a Bunsen burner. Calcium sulphate is not volatile. Moreover, calcium sulphate under the microscope is seen to be crystalline, precipitated sulphur is not crystalline.

Precipitation by Addition of an Alkali.

Dissolve 5 grs. of chloral hydrate in a little water and add some Liq. Potassæ. Chloroform will separate out.

Now add a drop of aniline and warm gently for 2 or 3

minutes—a penetrating nauseous odour of phenyl-isocyanide is given off:—



Precipitation by the Interaction of Solutions of Two Soluble Salts (see Incompatibility).

Calcination.

This process consists in heating substances (usually in a crucible) either to drive off carbonic acid, as in the case of lime, from which the name is derived, or of magnesia; or to cause chemical reduction, as in Calx Sulphurata.

Preparation of Calx Sulphurata.

Mix finely powdered calcium sulphate with one-seventh of its weight of wood charcoal. Heat in a crucible till the black colour has disappeared. Cool, and put the residue in a stoppered bottle.

Distillation.

This consists in converting a liquid into a vapour, and condensing this into the liquid form again.

Apparatus required.—Retort. Condenser. Receiver.

Water is distilled in order to separate it from fixed impurities, *e.g.*, earthy salts which remain behind.

Alcohol is distilled in order to separate it from solids dissolved in it and from water.

Essential oils are distilled in order to separate them from the plants in which they are contained.

Aquæ.—These are solutions of volatile substances in water. Two are prepared without distillation—Aqua Camphoræ and Aqua Chloroformi.

Aqua Camphoræ is prepared thus:—The camphor is first dissolved in 90 per cent. alcohol and then the solution is thrown into water, the camphor, being insoluble in water, is precipitated and is exposed to the action of the water in a state of finer subdivision than could be obtained in any other way.

Aqua Chloroformi:—chloroform is merely shaken up with water.

Two others, Aqua Menthæ Piperitæ and Aqua Menthæ Viridis, are made by distilling the volatile oil of these two species of mint with water. (Demonstration).

Note.—The oil alone boils at a much higher temperature than water, but when distilled with water the vapour of the oil comes over with that of water.

The others are prepared by distilling fruits, leaves, and flowers with water.

The Aqua Laurocerasi is standardized.

Destructive Distillation—is the process by which a body yields volatile substances not previously existing in it. (See formation of acetic acid from wood.

Fractional Distillation—is the process by which bodies that become volatile at different temperatures are separated.

Evaporation.

To crystallize out salts:—Put a hot saturated solution of potassium bitartrate in an evaporating basin on a sand bath and heat. As the water evaporates the salt crystallizes out and may be skimmed off the surface. (Explain meaning of expression “Cream of Tartar”).

In the preparation of Extracts—(see Extracts, p. 48).

Evaporation is used in many other processes of pharmacy.

PROCESSES INVOLVING SOLUTION, PRECIPITATION, AND
CALCINATION.*Preparation of Magnesia from Dolomite.*

(a) *Solution*.—*Preparation of Sulphate of Magnesia*.—Dissolve a piece of dolomite in dilute sulphuric acid. After effervescence has ceased filter. (For crystallised sulphate, this should be evaporated, and allowed to crystallise).

(b) *Precipitation*.—*Preparation of Magnesium Carbonate*.—Dissolve some sodium carbonate in a test-tube, with water. Mix this with solution (a) and boil. Throw the mixture on a filter, and wash with boiling water. (This ought to be continued till the washings cease to give a precipitate with barium chloride). Dry the precipitate on a water-bath.

(c) *Calcination*.—Put the dry powder into a crucible, and heat until some taken from the centre no longer effervesces with acid.

The preparation of the heavy carbonate of magnesium differs from that of the light carbonate in this principally—that in preparing the heavy carbonate the precipitation mixture is evaporated to dryness before washing with water and drying.

Liquor Magnesii Carbonatis (“*Fluid Magnesia*”).—Carbonate of magnesium is insoluble in water, but when freshly made and suspended in water and CO_2 passed into the solution it is dissolved as a bicarbonate.

IX.

Apparatus required.—Scales and weights. Minim and ounce measures. 2-oz. bottle. Wide test-tubes. Pestle and mortar or crucible.

Drugs required.—Myrrh. Sugar. Potassium carbonate. Ferrous sulphate. Spirit of nutmeg. Rose water. Caustic potash. Starch paste. Tartaric acid. Potassium iodide, pure and impure. Manganese binoxide. Sulphuric acid. Mercuric sulphate. Sodium chloride. Liquor Ammoniaë. Liquor Sodæ. Liquor Potassæ. Metallic mercury.

PROCESS INVOLVING PRECIPITATION AND SUSPENSION.

Preparation of Mistura Ferri Composita.

Weigh out 12 grs. of myrrh and the same quantity of sugar, 6 grs. of carbonate of potassium, and five grs. of sulphate of iron. Measure out $\mathfrak{m}\text{x}$. of spirit of nutmeg and 2 ozs. of rose water. Powder the myrrh in a mortar, add the carbonate of potash and sugar, triturating them with a little rose water so as to form a thin paste. Gradually add more rose water and spirit of nutmeg, rubbing thoroughly. Dissolve the sulphate of iron in about 3 fl. dr. of the rose water. Pour the mixture from the mortar into a 2-oz. bottle, add the dissolved sulphate of iron, and cork at once.

The preparation is an emulsion of myrrh in rose water containing in suspension ferrous carbonate, which is soon oxidised to ferric oxyhydrate (brown). The gum resin is soluble as a whole in alkalies, therefore the potassium carbonate also aids to get it into solution. The preparation is an example of intentional incompatibility.

(Compare with a specimen of Mistura Ferri Co. which has been kept for some time).

PREPARATION INVOLVING SOLUTION, EVAPORATION, AND CALCINATION.

Preparation of Iodide of Potassium.

Put about 10 grs. of caustic potash into a test-tube or evaporating basin, add water to dissolve it, and heat. Then add iodine crystal by crystal, shaking or stirring after each addition, until the colour disappears. Continue adding iodine until the colour becomes permanent.

Evaporate the solution to dryness. Take out a grain or two, and dissolve them in water. Add to the solution some starch paste and then tartaric acid, and a blue colour will appear. $6\text{KHO} + 6\text{I} = 5\text{KI} + \text{KIO}_3 + 3\text{OH}_2$.

Mix the remainder with about one-twelfth of its weight of charcoal in a test-tube or crucible, and heat until deflagration or incandescence appears. $\text{KIO}_3 + 3\text{C} = \text{KI} + 3\text{CO}$.

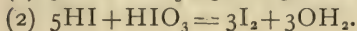
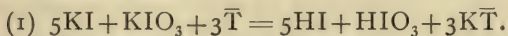
Add some water, shake, and filter.

Test the filtrate with starch paste and tartaric acid, as already described. No blue colour should appear.

The solution may be evaporated, and set aside to crystallise.

Testing the Purity of Potassium Iodide.

Iodate is the commonest impurity of iodide of potassium. Test the specimen supplied with starch paste and tartaric acid:—



Sublimation.

Sublimation consists in converting a solid into a vapour, and condensing to a solid again.

Preparation of Iodine.

Put into a test-tube a few grains of iodide of sodium, with some peroxide of manganese and a few drops of sulphuric acid. A thick dark vapour will rise, more especially if the mixture be heated. It will appear violet in places, but may be dark brown. If a wide tube be placed over the upper end of the test-tube, a brown deposit will form.

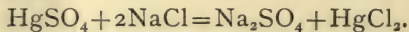
$2\text{NaI} + 2\text{H}_2\text{SO}_4 + \text{MnO}_2 = \text{I}_2 + \text{Na}_2\text{SO}_4 + \text{MnSO}_4 + 2\text{OH}_2$. The iodide is, as a rule, obtained from kelp.

Preparation of Corrosive Sublimate.

Mix a small quantity of sulphate of mercury and sodium chloride together in a mortar, with a grain or two of binocide of manganese.

Put them into a test-tube and heat.

A white cloud will appear on the tube, and will condense into a white crust at the upper cool part of the tube. Scrape it out, dissolve it in water, and it will be found to give a white precipitate with solution of ammonia, and a yellow precipitate with solution of soda or potash.

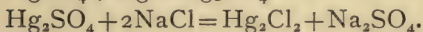
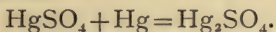


Mercuric Sulphate often contains some mercurous salt (Hg_2SO_4) which with the chloride of sodium forms calomel (Hg_2Cl_2), but the MnO_2 present with the sodium chloride generates free chlorine and this changes the Hg_2Cl_2 into HgCl_2 .

Preparation of Calomel.

Rub some sulphate of mercury in a mortar with

metallic mercury ; then add some sodium chloride and rub together again. Put the mixture into a test-tube, or into a crucible covered by a larger one or by an evaporating basin ; heat. A deposit will form in the upper part of the tube, or in the vessel covering the crucible. Scrape it off. Wash it with water by decantation.



The metallic mercury prevents any perchloride forming.

The water may be tested for corrosive sublimate by the tests already mentioned, or by the addition of chloride of tin, which, if any corrosive sublimate be present, will precipitate calomel. Add ammonia to the precipitate, and it will become black.

Another Test of Purity of Calomel.

Corrosive sublimate is soluble in water, alcohol, and ether.

Calomel is insoluble in water, alcohol, and ether.

Ether may be used instead of water to detect the presence of corrosive sublimate.

Experiment.—Put some of the calomel supplied to you in a test-tube. Shake with ether. Allow the calomel to subside, or filter the ether into an evaporating dish.

Set it to evaporate, and see whether any residue remains.

X.

Things required.—Cotton wool. Nitric acid. Sulphuric acid. Ether. Rectified spirit. Castor oil. Potatoes. Muslin. Wheat. Linen bag. Starch (various

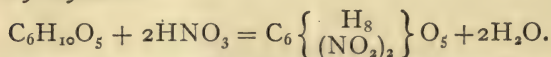
kinds). Microscope. Solution of iodine. Maltine. Cream of Tartar.

CONCERNING PLANTS USED FOR PHARMACEUTICAL PURPOSES.

The cell-walls, fibres, and tubes of plants consist chiefly of cellulose or lignin. These contain protoplasm and elaborated products, some of which are non-nitrogenous, like cellulose itself—such as starch, sugars, vegetable acids and salts, tannin, pectin, and fats, volatile oils, and resins, whilst others are nitrogenous, like alkaloids.

Cellulose or Cellulin $(C_6H_{10}O_5)_n$. Cotton wool. Prepared specimens.

Pyroxylin.—



Mix equal parts of strong nitric and sulphuric acids in a mortar; stir some cotton wool into it for three minutes with a glass rod. Put it then into a large quantity of water, and wash quickly by stirring and decantation. Drain it on filtering paper, and dry on a water bath.

Collodion.—This is pyroxylin dissolved in ether and rectified spirit. When collodion is painted on the skin it quickly dries by evaporation of the ether, leaving a fine film which is apt to crack. To prevent cracking the flexible collodion was introduced.

Flexible Collodion.—Measure out 48 minims collodion, and add to it 1 drop of castor oil and 2 drops of Canada turpentine (*see also* Collodium Vesicans).

Starch $(C_6H_{10}O_5)_n$.

Preparation of Starch.—(1) Scrape a potato and let the pulp fall over a piece of muslin tied over a test-glass.

Let water fall on it in a slow stream, and a white powder will fall to the bottom of the water.

(2) Put some wheat into a mortar, and pound it fine. Tie it in a linen bag and firmly rub the bag in the mortar, and let water flow slowly in while kneading the bag. The starch will come through in a white powder.

Gluten.—A sticky substance will remain in the bag. This is gluten. This is a nitrogenous substance, and on it the value of wheat as a food partly depends.

Microscopic Examination of Starch.—Put a few grains of the starches supplied on a glass slide, with a drop of water under a covering glass, and examine under a microscope. In several of them an appearance will be noticed as if they consisted of layers arranged round an eccentric nucleus. The granules actually consist of starch-granulose, soluble in cold water, and giving a blue with iodine, and starch-cellulose, insoluble in water, and giving a yellow with iodine.

Mucilage of Starch—Starch Paste.—Take a few grains of starch and rub in a mortar or cup with a teaspoon. Add enough *cold* water to make a smooth paste when rubbed with a spoon. Then add some *boiling* water, and the starch will swell up and form a smooth mucilage.

Take starch, and add it at once to boiling water. The mucilage it forms will probably be lumpy instead of smooth.

N.B.—This holds good for all starches and starchy foods, and is to be specially borne in mind in the making of gruels and starchy foods.

Glycerin of Starch.—See p. 16.

Test for Starch.—Add to a little starch mucilage, diluted with water in a test-tube, a drop of solution of iodine. A blue colour will appear. Boil the liquid, and the colour will nearly or quite disappear. Let it cool,

and the colour will reappear but will not be so bright as at first, because some of the iodine has volatilized and if boiled long enough no colour will return. Therefore the starch test for iodine should always be done *in the cold*.

Dextrin.—Put a grain of starch into a test-tube half full of water. Add a few drops of sulphuric acid. Boil for a few minutes. Take care that it does not spurt during boiling. Allow it to cool. It does not form mucilage. Add a solution of iodine to it, and it will give a much slighter blue than at first; and if the boiling has been sufficient, it will not give a blue at all.

Dextrin is also produced if starch be kept at a temperature of 320° F. for some time.

Dextrin is insoluble in alcohol. To 1 dr. of the solution above made, add some methylated spirit, and a white precipitate will fall.

By further boiling with acids starch is changed into *dextrose*.

Diastase.—An unorganised ferment formed from gluten during the process of malting of grain—the active principle of malt extract.

Effect of Diastase on Starch.—(1) Make some rather stiff starch paste in an evaporating basin.

(2) Boil a little maltine (=a malt extract) in a test-tube.

(3) Add a drop or two of the boiled maltine to the starch, and stir. No effect will be produced. Add now a small quantity of fresh maltine, when the paste will almost at once become liquid, the starch being converted first into soluble starch, and finally into maltose. The above experiment shows that heat destroys the action of diastase, and many specimens of maltine are inert so far as the diastase is concerned, because the ferment has been destroyed by too high a temperature

used in preparing them. Maltine is rich in predigested starch (dextrin, maltose) together with some of the albuminates and salts of the barley, so that it is much used as a food.

Tests for Glucose.—The four chief tests are known as Trommer's, Fehling's, Moore's, and the yeast test.

(a) *Trommer's Test.*—Put into a test-tube a piece of honey or grape sugar, with 1 dr. of water. Dissolve, and add a few drops of copper sulphate solution and a drachm of Liquor Potassæ (or Liq. Sodæ). Mix and boil. The blue colour will disappear, and a yellow or red precipitate of cuprous oxide (Cu_2O) will fall.

Note.—In this mixture the glucose keeps cupric hydroxide in suspension before reduction begins. Add the copper sulphate to the Liq. Potassæ, a pale blue precipitate of cupric hydroxide will fall. Now add some grape sugar, and it will redissolve. Boil and a yellow or red precipitate will fall. It is necessary in both Trommer's and Fehling's tests to have *excess of the reagent*.

(b) *Fehling's Test.*—This is simply a modification of Trommer's test. Instead of relying on glucose in the liquid to be tested to keep the cupric hydroxide in suspension, this is effected by the addition of potassium tartrate. Repeat the last experiment, using potassium tartrate. The cupric hydroxide will dissolve as it did with sugar. Boil, and the colour will remain unchanged. Add to the boiling liquid a drop or two of solution of glucose, and a yellow or red precipitate will fall at once.

(c) *Moore's Test.*—To 1 dr. of glucose solution add its own bulk of Liq. Potassæ (or Liq. Sodæ). Boil the upper part of the liquid, and it will become of a brownish

colour, varying in depth with the strength of the solution used.

(d) *Yeast Test*.—Make about 6 ozs. of a solution of glucose. Divide it into two portions, and put each into a bottle. Add to one a piece of yeast about the size of a filbert. Stop the necks loosely and leave them in a warm place for 24 hours. Test the solution containing yeast for sugar, if not all reduced add a little more yeast and leave again for 24 hours. Test again to see if all the sugar is reduced, and if so, then take the specific gravity of the two solutions. A difference of 1° on the hydrometer scale corresponds to 1 grain of sugar per fluid ounce.

XI.

(1) *Cane-sugar*.—Syrupus. Dissolve 2 drs. of sugar in 1 fl. dr. of water in a test-tube by the aid of heat. Cool it under the tap, and then add enough water to make its weight $3\frac{1}{2}$ drs.

(2) *Test for Cane-sugar*.—Dissolve a few grains of sugar in water. Divide the solution into two parts. To one add a few drops of copper sulphate solution and some Liq. Potassæ. The cupric hydroxide will remain in solution. Boil, and no reduction will occur. (Compare result obtained with grape-sugar).

(3) To the other portion add some dilute sulphuric acid. Boil, and then add excess of Liq. Potassæ and a few drops of copper sulphate solution. The cupric hydroxide will remain in solution. Boil; a yellow or red precipitate of cuprous oxide will now fall. (Conversion of cane-sugar [sucrose] into glucose).

Diastase and yeast also convert cane-sugar into glucose.

GUMS.

Gum-acacia or Arabin.—This consists of gummie or arabic acid, partially combined with lime, magnesium and potassium. It may practically be regarded as an acid calcium salt of gummie or arabic acid. Gummie acid $(C_6H_{10}O_5)_2.OH_2$, is nearly allied to starch and dextrin. (Starch, dextrin, and sugar are its chief adulterations).

(1) Make a solution of powdered gum-acacia in water. Test its reaction with litmus. It will be found to be acid. Pour a little of the mucilage into methylated spirit. A precipitate will occur, arabin being insoluble in alcohol.

(2) To another portion of the mucilage add a concentrated solution of borax. A gelatinous precipitate occurs.

(3) To a further portion of the mucilage add some solution of subacetate of lead. A white clotty precipitate of lead arabate will fall. (Solution of lead acetate gives no precipitate).

(4) Repeat (3) with Liquor Ferri Perchlor. instead of subacetate of lead. Ferric arabate will be precipitated, and seeing that some kinds of gum acacia contain tannin a reaction with tannin may also be obtained.

(5) Starch and dextrin, present as adulterations, may be detected by the iodine colour test. Commercial dextrin consists of unchanged starch and of erythro-dextrin, which gives a reddish brown colour with iodine.

Add to another portion of the mucilage a drop of iodine solution.

(6) Dextrin and sugar may be detected by the usual test:—To another portion of the mucilage add a few drops of copper sulphate solution and excess of Liq.

Potassæ (or Liq. Sodæ). A gelatinous, clotty, blue precipitate of cupric arabate forms. (Cf. result with { dextrin }
{ glucose }). The precipitate does not turn red or black (as cupric hydroxide would) on boiling.

(7) *Tragacanth*.—This consists mainly of a mixture of a substance nearly identical with *arabin* (but which is not so soluble in water), and of *bassorin* (which only swells up in water). Put a small piece into water in a test-tube, and let it stand. It will swell up much. Pour the water off into another test-tube, and add to this its own bulk of methylated spirit. No precipitate will fall.

(8) Add a drop of iodine solution to the swollen gum. It will give a blue tint. This is due to the starch in the *tragacanth*.

(9) *Mucilage of Tragacanth* (B.P.).—This is an incomplete solution of powdered gum-tragacanth in water, 6 grs. to 1 oz.

Notice that the powdered tragacanth is first diffused through a small quantity of strong alcohol in which it is insoluble. This ensures the fine subdivision of the powder and prevents clotting when it is mixed with water.

It is contained in *Lotio Hydrarg. Nigra*.

(10) *Compound Tragacanth Powder*.—Contains powdered tragacanth, gum, starch, and sugar.

The chief use of it is to thicken mixtures containing insoluble substances.

The particles of tragacanth, being separated by the other constituents of the powder, are prevented from running into lumps when rubbed up with water.

(11) *Glycerinum Tragacanthæ*.—Previously prepared (see p. 16). This is often known as Proctor's paste, and is much used in making pills.

Mucilage of tragacanth is inferior to mucilage of gum acacia as an emulsifier of oils, but it is superior as a suspender of insoluble powders, because it forms a much more viscid fluid (*see* Mistura Cretæ, Mistura Guaiaci).

XII.

Pectin, or vegetable jelly. This has the property of gelatinising when strong hot solutions are cooled.

Irish moss mucilage is very frequently used to emulsify cod-liver oil.

Chlorophyll, or green colouring matter—*vegetable albumin*—will be considered under the preparation of green extracts.

(1) *Vegetable mucilage* is somewhat like gum, it is abundant in linseed.

Preparation of Linseed Tea.—Put 80 grs. of linseed (not crushed) into a jug or beaker with $\frac{1}{2}$ dr. sliced liquorice root. Pour over these 5 fl. ozs. of boiling water, and allow the mixture to stand for two hours.

(2) *Tannic and Gallic Acids*.—Gallic acid is trihydroxybenzoic acid, $C_6H_2(OH)_3COOH$. It is got by the hydrolysis of tannic acid. When tannic acid is boiled with dilute sulphuric acid each molecule takes up a molecule of water and yields two molecules of gallic acid. Reversely two molecules of gallic acid can combine with the elimination of water to form tannic acid.

Tannin is a term used by different people in different senses—some mean by it tannic acid, whilst others in-

clude in it a considerable number of bodies, some of which are glucosides, which are allied to tannic acid.

There are several varieties of tannin, and they may be divided into:—

1. Those giving a blue or black precipitate with ferric salts, and are derivatives of pyrogallol.

2. Those giving an olive-green precipitate with ferric salts, and are derivatives of catechol.

(3) Put a little tannin into a test-tube with water, and shake. The liquid will froth much. Add to some of this a little ferric chloride. A blue-black precipitate falls. Boil, and the liquid will be partially decolourised. Repeat this, using solution of ferrous sulphate, a light bluish colour will be produced.

(4) Put a drop of Tinct. Catechu into a test-tube; add water, and then a drop of ferric chloride solution. A dark greenish precipitate will fall.

(5) Repeat this, using compound infusion of gentian—a greenish colour will be produced.

(6) Repeat this, using infusion of calumba.

(7) Repeat this using infusion of quassia.

Tannic acid precipitates from solution gelatin, albumen, and alkaloids:—

(8) Add a little solution of tannic acid to (a) solution of gelatin, to (b) dilute white of egg, and to (c) a solution of strychnine. Observe the white precipitates.

(9) Repeat this with *gallic acid*. No precipitates will occur.

Tannic acid may therefore be used as an antidote in alkaloidal poisoning.

(10) Test the action of ferric chloride on solution of gallic acid—a blue-black precipitate is formed.

Tannic acid forms insoluble tannates with salts of antimony or bismuth. (It is used as an antidote in poisoning by tartar emetic).

Gallic acid forms soluble gallates with salts of antimony* or bismuth.

(11) Compare the taste of solutions of the two acids.

Fats and Fixed Oils.—Nearly all fats and fixed oils are compounds of glycerin with fatty acids. They belong to the class of “saline ethers” or “esters,” glycerin being an alcohol. Glycerin can combine with three molecules of acid, being triatomic. The chief fatty acids are oleic, stearic, and palmitic, the former predominates in the oils, the other two in solid fats.

Olive oil is chiefly trioleate of glyceryl.

Tallow is chiefly tristearate of glyceryl.

Lard is chiefly a mixture of these two.

Cacao butter is chiefly a tritheobromate of glyceryl.

Other fats:—In *wax*, glyceryl is replaced by ceryl.

„ In *spermaceti* glyceryl is replaced by cetyl.

„ In *lanolin* glyceryl is replaced by cholesterolin.

Volatile oils are not compounds of fatty acids and glycerin; they are hydrocarbons generally of the terpene series ($C_{10}H_{16}$). (See p. 41).

(12) Put a drop of olive oil, and another of clove oil on a piece of blotting paper, so that two translucent spots are formed. Shake the paper, and after a time the spot formed by the clove oil will have disappeared.

(13) Fats and oils are insoluble in water, but soluble in alcohol, ether, and chloroform. Put a little chloroform into a test-tube, and add a drop of olive oil. It will dissolve.

(14) Add a drop of sulphuric acid to a few drops of cod-liver oil (*oleum morrhue*) on a porcelain slab. Mark the violet colouration due to the presence of biliary constituents.

* According to the “British Pharmacopœia.”

(15) Lanolin takes up water with considerable ease. Rub up a piece of lanolin about the size of a bean in a mortar, and add to it water from a minim measure until it no longer takes up any more. Note the quantity of water thus used. (See Adeps Lanæ Hydrosus).

(16) *Lard* does not possess this property of taking up water. Try this, as in the case of lanolin.

Oils are divided into two classes—drying and non-drying.

Linseed oil is a type of the former, for on exposure to the air it becomes oxidised forming a resinoid substance. *Olive oil* is a non-drying oil, and does not behave in this manner.

Fixed oils and fats used in pharmacy, if heated under pressure with water, undergo decomposition, being split up into free fatty acid and glycerin (with the exception of wax spermaceti and lanolin).

Glycerin is also liberated when fixed oils or fats are shaken up with alkalies. The alkalies unite with the fatty acids forming *soaps*. The process is called "*saponification*."

Action of the various alkalies :—

- i. Olive oil + KOH = potassium oleate (soft soap).
- ii. „ + NaOH = sodium oleate (hard soap).
- iii. „ + NH₄OH = ammonium oleate (Lin. Ammoniaë).
- iv. „ + lime water = calcium oleate (Lin. Calcis).
- v. Stearin + NaOH = sodium stearate (curd soap = Sapo Animalis).
- vi. Olive oil + PbO = lead oleate (Emplastrum Plumbi).

Compare action of alkalies on "mineral fats," e.g., paraffin, vaselin. In these cases no soaps are formed.

XIII.

Drugs required.—Sodium carbonate. Alcohol. Iodine. Oil of peppermint. Fir-wood oil. Light magnesia. Guaiac-resin. Copaiba. Gamboge.

Oleo-resins and Balsams.—These are natural exudations from plants. They contain a mixture of volatile oil and resin. The oil may be distilled over by means of aqueous vapour, leaving the resin.

The balsams are liquid oleo-resins of such a consistence as to form convenient dressings for wounds. Several of them contain benzoic or cinnamic acid (*e.g.*, balsam of Peru, or balsam of Tolu). Others do not (*e.g.*, balsam of copaiba). Benzoin and storax contain benzoic acid, and are reckoned by some as balsams although they are solid.

Volatile Oils.—These oils have the general formula (C_nH_{2n-4}). Oil of turpentine ($C_{10}H_{16}$) is a representative. They consist usually of liquid hydrocarbons or *eleoptenes* with oxidised products of the same, usually solid and in solution called *stearoptenes*.

SOLUBILITY.—They are sparingly soluble in water, but some are more soluble than oil of turpentine. They are freely soluble in alcohol.

They are soluble in fixed oils. Add a drop of oil of cloves to about $\frac{1}{2}$ dr. of olive oil. Solution will take place. Volatile oils are carminatives and for that reason they are often added to cod-liver oil.

SPIRITS.—These are solutions, with the exception of Sp. Vini Gallici and Sp. Rectificatus, of volatile oils or other volatile substances in 90 per cent. alcohol. Those prepared from volatile oils have the strength 1 in 10,

with the exception of Sp. Juniperi which is 1 in 20, because in this case a strength of 1 in 10 would not give a clear solution.

Poured into water they form cloudy precipitates, but the oil is infinitely more finely divided than could be attained in any other way. Hence the use in prescriptions of the spirits rather than the volatile oils themselves.

AQUÆ.—See p. 23.

Aquæ may be quickly prepared (unofficially) either by dissolving a "spirit" in water—as is done officially in the case of Aqua Camphoræ—or by shaking the volatile oil with magnesia, adding water, and then filtering. The oil is diffused through the magnesia, the surface which it offers (and thus its solubility) being in this way increased. This method is also used in preparing some of the Vapors, e.g., *Vapor Pini* (St. B. H. Ph.):—Take ℥5 of fir-wood oil, 4 grs. light carbonate of magnesia, and rub them together. Add 3 j. of water and rub again. Put this into an inhaler with $\frac{1}{2}$ pint of hot and $\frac{1}{2}$ pint of boiling water, and inhale the vapour.

Stearoptenes are oxidised, but not acid components of volatile oils. Camphor, $C_{10}H_{16}O$, is a good example. Its solubility in water and spirit have been already tested.

Resins.—Acid products of the oxidation of volatile oils. They are insoluble in water, but soluble in spirit.

Put a piece of guaiac resin in a test-tube with water; it will not dissolve, even on heating. Pour off the water and add spirit, warming; the resin will dissolve. Add now a little water, and precipitation will take place.

They are soluble in alkalies. Divide the water containing the suspended resin into two parts. Add to one some potash, and to the other some ammonia. In each

case the resin will redissolve. (See Tinct. Guaiaci Ammoniata).

Oleo-resins behave like mixtures of volatile oils and resins. The effect of alkalies on them in making an emulsion has already been ascertained (see p. 7).

When resins or oleo-resins are prescribed it is advisable to use mucilage to keep the particles separate. Sometimes the addition of alkalies to form soapy emulsions is also advisable.

Put into a bottle about 2 ozs. of water, and pour in about $\frac{1}{2}$ dr. of copaiba. It will not mix, but will float about as a large globule. Put in some liq. potassæ, and shake. A somewhat milky liquid will be formed. Addition of about a drachm of mucilage will make a still better mixture (see Hst. Copaibæ, St. B. H. Ph.).

Gum-resins.—Bodies consisting of gum and resin, with a mere trace of volatile oil. When mixed with water they form mixtures without the addition of any extra gum.

Put a small piece of ammoniacum in a mortar, and rub it up with water. It forms a perfectly smooth emulsion (see Mistura Ammoniaci).

XIV.

Drugs required.—Calumba root. Rhubarb root. Iron chloride. Animal charcoal. Quassia chips. Iodine solution. Ammonia. Lime water. Methylated spirit. Lead subacetate. Logwood chips. Lettuce.

Apparatus required.—Infusion pots. Evaporating basins.

Percolator. Filters. Test-tubes. Pestles and mortars. Thermometers. Water-baths and stands. Calico. Tincture press.

Most vegetables contain, in addition to the principles for which they are used as medicines, a good deal of inert matter. The chief object in making pharmaceutical preparations from crude drugs is to get out the greatest amount of the active ingredient with the least amount of inert matter. Besides this we have to consider what preparation is likely to be least disagreeable to the patient, most convenient for administration, and least likely to spoil.

Hard ligneous tissue is not only useless but objectionable, as it is hard, unpleasing to the palate, and indigestible. The first process is therefore to get rid of it. This is usually done by dissolving out the soluble active substances, and leaving the hard, woody parts behind.

The solvent is chosen according to the nature of the active principle, and the manner in which it is to be applied in medicine.

The usual solvents are water and alcohol, but other solvents, such as ether, glycerin, dilute acids, are used in special cases.

Alcohol dissolves out most active ingredients, leaving behind those that are inert, and so it is the solvent most frequently applied. Thus in the British Pharmacopœia there are 67 tinctures, while there are only 22 infusions, and 3 decoctions.

In some cases, however, principles insoluble in alcohol may be desired, *e.g.*, mucilage, and here water is used.

In other cases the active principle may be equally soluble in alcohol and in water, and the process of ex-

traction by water may be preferred, as being less expensive, *e.g.*, Ext. Gentianæ.

In some instances water extracts together with the active principles, other substances which tend to make the watery solution decompose (*e.g.*, mucilage and starch). Alcohol leaves these behind.

In other instances both alcohol and water may be used, *e.g.*, Ext. Jalapæ, where alcohol dissolves out the active principles (resins) and water dissolves out the mucilage, &c., required to give the extract a proper consistence.

Infusions are generally made with boiling water, but in two instances cold water is used (calumba, quassia).

(1) Put a small piece of calumba root into each of two test-tubes. Half fill one of the tubes with cold water, and the other with hot water. Let them stand a few minutes, then pour the liquids into two other test-tubes, and test them for starch by the addition of a drop or two of solution of iodine.

(2) *Preparation of Infusum Rhei*.—Take 4 drs. of sliced rhubarb root, place it in a covered vessel (an infusion pot), and infuse with 10 ozs. of boiling distilled water for 15 minutes. Strain off the water, which is now *infusum rhei*.

(3) Put some of the liquid into each of six test-tubes.

To (i.) add ammonia. The colour will be deepened.

„ (ii.) „ lime water. Colour is deepened, and a ppt. will fall, especially on heating.

„ (iii.) „ perchloride of iron. A finely divided black ppt. will fall.

„ (iv.) „ lead subacetate solution. A dense ppt. will fall.

To (v.) add animal charcoal, shake and filter. The filtrate will be colourless.

„ (vi.) „ twice its volume of methylated spirit, and set aside for 24 hours. A precipitate of mucilaginous matter will be then seen.

Chrysarobin, rhubarb, senna, all contain chrysophanic acid, which gives a fine dark red solution with alkalis. The urine of patients taking rhubarb or senna turns dark red on adding an alkali, the colour disappearing when the urine is again made acid.

(4) *Preparation of Infusum Quassiae*.—Take 44 grs. quassia chips, and infuse with 10 fl. ozs. of cold distilled water for 15 minutes. Then strain. Apply to this the same tests as those given under (3).

The Infusum Cinchonæ Acidum contains aromatic sulphuric acid to aid in the extraction of the alkaloids (*see also* Extractum Cinchonæ Liq.). The Infusum Rosæ Acidum contains acid merely to produce an agreeable red colour—this colour changes to green or blue or brown if the acid reaction of the infusion be changed by the addition of an alkali.

Experiment :—

1. Neutralize some acid infusion of roses.
2. Make alkaline some acid infusion of roses.

(5) *Preparation of a Decoction*.—Take $\frac{1}{2}$ oz. logwood chips, and add $\frac{1}{2}$ pint of distilled water. Boil for 10 minutes in a porcelain dish. Strain through a plug of cotton wool or tow in the neck of a funnel. The liquid is a decoction of logwood. (*Cf.* Decoctum Hæmatoxyli).

(6) Dilute the liquid with three times its volume of cold water, and put portions into each of five test-tubes.

- To (i.) add liq. ammoniæ. Purple colouration.
,, (ii.) ,, lime water. A purple ppt. falls, leaving the liquid colourless.
,, (iii.) ,, lead subacetate solution. A purple ppt. falls, leaving the liquid colourless.
,, (iv.) ,, ferric sulphate solution. A black ppt. falls (ink).
,, (v.) ,, animal charcoal, shake and filter. The filtrate is colourless.

(7) *Preparation of Tinctures*.—Tinctures are alcoholic solutions. Some are prepared by simple solution or mixing; others by maceration for seven days; others by percolation. (Demonstrate the percolator and the process of percolation).

The strength of alcohol used is not always merely a matter of the extraction of the active principle, *e.g.*, the Tinctura Calumbæ is made with 60 per cent. alcohol, although 45 per cent. alcohol would extract the active principle. But so weak an alcohol would also extract a quantity of mucilaginous and other inert substances which are insoluble in strong alcohol, but soluble in water and therefore in weak alcohol.

There are five ammoniated tinctures—that of ergot requires the ammonia for the better extraction of the active principles. In the other four the ammonia is present, at least chiefly, for its medicinal use, *e.g.*, in the Tinctura Quininae Ammoniata as a stimulant to the heart, in the Tinctura Opii Ammoniata as a stimulant to the respiratory centre, in the Tinctura Valerianæ Ammoniata to aid the stimulant action of the drug on the nervous system, and to bring out the characteristic odour of the drug, and Spiritus Ætheris tends in the Tinctura Lobeliae Ætherea to counteract the depressant action of Lobelia on the heart.

(8) *Fresh Extracts*.—There are four fresh extracts (Colchicum, Taraxacum, Belladonna, Hyoscyamus) in the B.P., two of which are derived from a part of the plant which contains chlorophyll, and are therefore *green*. The two green extracts are from Belladonna and Hyoscyamus. The Extractum Lactucae is no longer in the B.P., but is used here for the sake of convenience.

Preparation of a Green Extract.—Extractum Lactucae:—

(α) Take lettuce leaves and herb, bruise them in a mortar, and press out the juice. Heat this gradually up to 130° F.

(This temperature coagulates the green colouring matter, chlorophyll, without affecting any of the albumen).

(β) Filter through calico, and *preserve carefully* the green colouring matter.

(γ) Heat the strained liquid to 200° F. and filter.

(This will coagulate the vegetable albumen, which if left would decompose).

(δ) Evaporate the filtrate over a water-bath to the consistence of a thin syrup, and then add to it the green colouring matter previously separated, stirring the whole together. Continue the evaporation at a temperature not over 140° F. till the extract is of suitable consistence for making pills.

All the other extracts are from drugs not in a fresh condition.

Some are solid and some are liquid.

Of the solid extracts, some are alcoholic some are aqueous, and one is both alcoholic and aqueous (Ext. Jalapæ).

Of the liquid extracts, some are alcoholic some are aqueous, one is both alcoholic and aqueous (Ext.

Taraxaci Liq.), one is made with dilute hydrochloric acid (Ext. Cinch. Liq.), and one with ether (Ext. Filicis Liq. : see also Ext. Strophanthi).

Succi.—To every three volumes of juice is added one volume of 90 per cent. alcohol, to precipitate gummy and albuminous substances and as a preservative.

Filter after 7 days.

Succus Limonis is an exception—it has no alcohol added because it is always used fresh.

See also p. 71.

Syrupi.—They are solutions of various substances in a nearly saturated solution of refined sugar.

The object of the sugar is:—

1. To please the palate.
2. A strong sugar solution is a preservative, though a weak one tends to fermentation.
3. Sugar retards many chemical changes, especially the oxidation of ferrous salts, *e.g.*, Syrupus Ferri Iodidi—the iodide of iron is very unstable, but in the presence of sugar it will keep in good condition for a long time.

See also p. 71 concerning Syrupus Limonis.

XV.

GLUCOSIDES.

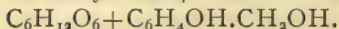
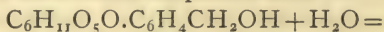
Glucosides are compound ethers (esters) composed of sugar and hydroxyl substances.

They split up on heating with acids, or sometimes with alkalis, or when acted upon by certain unorganised ferments.

Salicin may be taken as a type of glucosides.

It is crystalline ($C_6H_{11}O_5O.C_6H_4CH_2OH$).

1. Heat a few grains for 3 or 4 minutes in a test-tube with dilute sulphuric acid.



Glucose.

Salicylic Alcohol.

Make the solution slightly alkaline with *Liquor Potassæ* and test for sugar with Fehling's solution (*see* p. 33).

This reaction is typical of all glucosides.

The solution must be made alkaline, because the copper test for sugar is given only in alkaline solution.

2. Dissolve a few grains in strong sulphuric acid—the solution becomes red. Strychnine with strong H_2SO_4 remains colourless. Add water—the red colouring matter (rutulin) is precipitated.
3. Heat a few grains with a little bichromate of potassium and a few drops of strong sulphuric acid and some distilled water—odour of meadow-sweet (salicylic aldehyde).
4. Heat a few grains cautiously in a test-tube until they melt—odour of meadow-sweet.

Salicylic alcohol is oxidised in the body to salicylic acid.

ALKALOIDS.

These substances have an alkaline reaction, and hence their name. They all contain nitrogen, and were supposed to be built upon the type of ammonia, so that they were regarded as compound ammonias in which one or more atoms of hydrogen were replaced by organic radicals. Many of the most important contain a pyridine

or a quinoline radical, and lately it has been proposed to limit the term alkaloid to organic bases derived from them, while some of the other compound ammonias are known as amines or imines, and several from their toxic properties are termed toxines.

They are nearly all crystalline solids. They are sparingly soluble in water but their salts are more soluble, so that a general method of obtaining them is to treat the substance in which they are, with a dilute acid, and then to precipitate them from the solution by adding ammonia.

GENERAL TESTS FOR ALKALOIDS.

(1) Solutions of alkaloids (or their salts) give with liquor potassæ, or liquor sodæ, or other alkaline solutions, a white precipitate. (The precipitate with *morphine* is soluble in excess).^{*}

(2) *Tannic acid* gives a white, clotty precipitate.

(3) *Mercuric iodide* dissolved in potassium iodide (= Mayer's reagent) gives a yellowish-white precipitate. (No precipitate with caffeine).

(4) The same takes place with the corresponding bismuth salt.

(5) *Animal charcoal*, shaken with solutions of alkaloids, retains most of the alkaloid, which can be again extracted from it by a suitable solvent.

(6) Solution of iodine, dissolved in potassium iodide (= Wagner's reagent), gives a dark or yellowish-brown precipitate of the periodide of the alkaloid. (No precipitate with caffeine).

* Quinine precipitated by ammonia is redissolved in excess of the reagent.

SPECIAL REACTIONS OF CERTAIN ALKALOIDS.

—	HNO ₃ .	H ₂ SO ₄ and Pot. Bich.	Neutral ferric chloride.	Chlorine water and ammonia.
Atropine* . .	Nil	Discoloured	Nil	—
Brucine . .	†Red	Orange	Nil	—
Strychnine .	Nil	†Bluish to red	Brownish-green precipitate	—
Morphine . .	Yellow	Brown	†Blue (if crystals be used)	—
Quinine . . .	Nil	Light yellow	Nil	†Green

Physostigmine—aqueous solution of sulphate, mixed with Liq. Ammonia and evaporated to dryness on a water bath, leaves a bluish residue, the solution of which in very dilute acid (*e.g.*, acetic) is red by reflected and blue by transmitted light.

A METHOD OF PREPARING MORPHINE FROM OPIUM.

Heat a mortar thoroughly by filling it with boiling water.

Take some opium, and rub it up in the hot mortar with about twice its weight of boiling water. Filter through calico. Add to the filtrate very dilute ammonia drop by drop until it is neutral. Then add to the filtrate a saturated solution of calcium chloride until a precipitate ceases to form—then evaporate and crystallise. The opium contains meconate of morphine, which is dissolved out by the hot water. With calcium chloride a reaction occurs, with formation of hydrochloride of morphine,

* The physiological effect on the pupil is the only reliable test of atropine.

† Indicates the important reaction.

which remains in solution, and deposition of meconate of lime.

To purify the hydrochloride of morphine, dissolve in water; add animal charcoal. Shake and filter. To the filtrate add *Liq. Ammoniæ*.

Filter, redissolve the preparation in hot dilute hydrochloric acid. Allow it to cool.

A METHOD OF EXTRACTING MIXED ALKALOIDS FROM CINCHONA BARK.

(1) Rub up some cinchona bark with milk of lime (lime rather more than half the weight of the bark, and water two and a half times as much as the lime) into a paste. The cinchona bark contains the alkaloids as *salts*. The lime combines with the acids of the bark, setting free the alkaloids. Dry in a water-bath.

(2) Powder the residue and extract with chloroform by percolation. (The chloroform which percolates through contains the alkaloids in solution).

(3) Place this solution in a retort; add water and render acid with sulphuric acid. Distil off the chloroform. (In this process the alkaloids are reconverted into salts, which remain dissolved in the acid water).

(4) Allow the remaining solution to cool and then add ammonia to it.

This will cause precipitation of quinine, cinchonine, cinchonidine, and quinidine. Some of the quinine may, however, remain dissolved in excess of the ammonia.

(5) Collect the precipitate. Wash and dry.

XVI.

PRESCRIPTIONS.

Prescriptions.—These are written directions—

- | | |
|-------------------------|----------------|
| (a) For the preparation | } of remedies. |
| (b) For the use | |

The directions for preparation are for the use of the dispenser, and are usually written in Latin. Those for the patient are usually written in English.

The directions for the dispenser consist of three parts, *i.e.*, directions (a) to take; (b) what to take; (c) what to do with that which he has taken. Thus:—

Superscription. \mathcal{R} = Recipe = Take.

Inscription, or	} Quantity of substance or substances.
Designation of material.	

Subscription. Mix, dissolve, &c.

The “Signature” forms the directions for the patient, and is usually preceded by the word “Signe” or “Signetur” = sign, or let it be signed, and this is usually abbreviated to “Sig.”

The quantity—ounces, drachms, &c.—is to be put in the accusative, and after the substance itself, which is written in the genitive, *e.g.* :—

Take—of Rhubarb root—1 oz. is rendered—

Recipe—Rhei radice—unciam unam.

The word “misce” (mix) is the word which occurs most commonly in the subscription, and is usually abbreviated to “M.”

The rule in prescribing is that the medicine should cure quickly, safely, and pleasantly. To secure this there are four parts to the *model* prescription corresponding to these requirements:—

- | | | | |
|---------------|---------|------------|------------|
| 1. Cure | Curare | Basis | Basis. |
| 2. Quickly | Cito | Adjuvant | Adjuvans. |
| 3. Safely | Tute | Corrective | Corrigens. |
| 4. Pleasantly | Jucunde | Vehicle | Vehiculum. |

Of course many prescriptions do not contain each of these four parts.

Example:—

Superscription—Recipe.

Inscription	{	Magnesii Sulphatis uncias duas ē semisse (Basis).
		Extracti Glycyrrhizæ Liquidi drachmas quattuor (Adjuvant).
		Tincturæ Cardamomi Compositæ unciam unam (Corrective).
		Spiritus Ammonizæ Aromatici drachmas quattuor (Corrective).
		Infusum Sennæ ad uncias decem (Vehicle).

Subscription. Misce.

Signature. One tablespoonful to be taken when required.

Written in the ordinary way the above prescription would be as follows:—

December 13th, 1901.

Rx.	Magnesii Sulphatis	...	...	℥ iiss.
	Ext. Glycyrrh. Liq.	...	...	℥ iv.
	Tinct. Card. Co.	...	...	℥ j.
	Sp. Amm. Aromat.	...	...	℥ iv.
	Inf. Sennæ	...	...	ad ℥ x.

Misce. One tablespoonful to be taken when required.

J. C.

Mrs. Jones.

The direction written in English may, of course, be written in Latin. But as this direction appears on the label of the bottle of medicine, when it is written in English the patient has the opportunity of checking the dose on the prescription with the dose on the label.

It is usual nowadays to prescribe *a single dose*, and to direct the dispenser to send an appropriate number of doses. The following prescription is written in this way :—

December 13th, 1901.

R _x .	Ferri et Ammonii Citratis	...	gr. v.
	Sodii Bicarbonatis	...	gr. x.
	Spiritus Chloroformi	...	℥ v.
	Infusum Calumbæ	...	ad ̄ j.

Fiat mistura ter die sumenda.

Mitte ̄ xij.

J. C.

Mrs. Jones.

It is evident that by writing the prescription in this way the physician has escaped the labour of multiplying the dose of each ingredient by 12.

Written in the other way it would be as follows :—

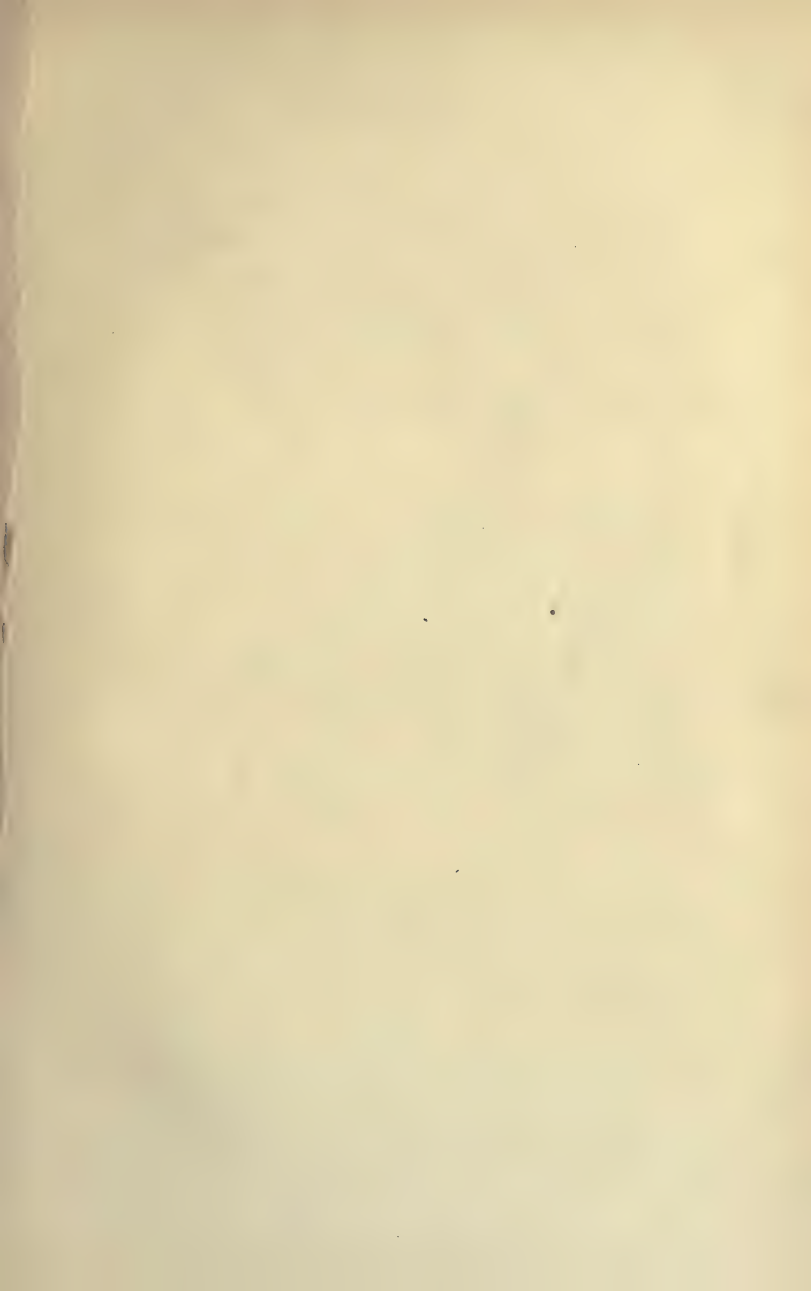
December 13th, 1901.

R _x .	Ferri et Amm. Cit.	...	̄ j.
	Sodii Bicarbonatis	...	̄ ij.
	Spiritus Chloroformi	...	̄ j.
	Infusum Calumbæ	...	ad ̄ xij.

Misce. Two tablespoonfuls three times a day.

J. C.

Mrs. Jones.



How to Prescribe and to Dispense Oils (see p. 6).

Example (1):—

R̄.	Ol. Morrhuæ	...	...	...	℥ ij.
	Mucilaginis Acaciæ	...	...	...	℥ ij.
	Sacchari Purificati in pulvere...				gr. xxx.
	Aquam Carui	...	...	ad	℥ j.
	Bis die. Phialâ prius concussâ.				

Mitte ℥ vj.

Place the mucilage of acacia (B.P.)* in a mortar, and to it add alternately, in portions, the Ol. Morrhuæ and the Aq. Carui, with constant trituration in one direction. The sugar can be dissolved in the latest additions of the Aq. Carui. In this way the oil becomes subdivided into very small particles, all of which being covered with a layer of mucilage, are prevented from running together again.

Shaking up mucilage in a bottle, with the oil added in small portions, will not break up the oil so effectively as tritulating in a mortar.

Example (2):—

R̄.	Olei Terebinthinæ	...	...	...	℥ xx.
	Mucilaginis Acaciæ	...	...	...	℥ ij.
	Aquam Carui	...	...	ad	℥ j.
	t.d.s. Phialâ prius concussâ.				

Mitte ℥ viij.

The method of dispensing same as in (1).

* Mucilage must always be freshly made. It is always faintly acid, but on keeping may, from fermentation, become decidedly acid—and such mucilage will spoil any emulsion.

How to Prescribe and Dispense Resins, Gum-Resins, and Oleo-Resins (see p. 43).

Resins.—See *Mistura Guaiaci*, B.P.

Gum-Resins.—See *Mistura Ammoniaci*, B.P.; in this case no gum is added, because it is already there.

Oleo-Resins.—

R.	Copaibæ ...	...	...	...	℥ xv.
	Mucilaginis Acaciæ	...	...	...	3 ij.
	Aquam Destillatam	...	ad	...	3 j.

Or—

R.	Copaibæ ...	...	...	...	℥ xv.
	Liq. Potassæ	...	...	...	℥ x.
	Aq. Destill.	...	...	ad	3 j.

A better emulsion is obtained by using both the mucilage and the Liq. Potassæ (see the *Haustus Copaibæ* of the St. B. H. Ph.):—

R.	Copaibæ ...	...	...	...	℥ xv.
	Mucilaginis Acaciæ	...	...	...	3 j.
	Liquoris Potassæ	...	...	...	℥ v.
	Sp. Ætheris Nitrosi	...	...	...	℥ xv.
	Aquam Camphoræ	...	ad	...	3 j.

t.d.s. Phialâ prius concussâ.

Mitte 3 vj.

Put the mucilage into a bottle, add the copaiba by degrees, then further emulsify by adding the Liquor Potassæ, then add the Aqua Camphoræ, and finally the Spiritus Ætheris Nitrosi,* shaking throughout.

* Spirits and other preparations containing alcohol should always be added last to emulsions.

Or, the oleo-resin may be broken up with the mucilage in a mortar.

The action of *Liquor Potassæ* has been already explained (*see* p. 7).

How to Prescribe and Dispense Resinous Tinctures.

Resinous tinctures are precipitated on the addition of water, resins being insoluble in water.

(*α*) With mucilage:—

R.	Tincturæ Cannabis Indicæ	...	3 j.
	Mucilaginis Tragacanthæ	...	3 ij.
	Aquam	... ..	ad 3 vj.

Fiat emulsio, cujus capiat æger duo cochlearia magna sextis horis. Phialâ prius concussâ.

If the mucilage be poured into the tincture, it will form clots; but if the tincture be added gradually to the mucilage, with constant agitation, this may be avoided.

Therefore place the mucilage in a bottle, and add the tincture and the water alternately in small quantities, shaking between each addition.

(*β*) With gum:—

When powdered gum is used, it should be added to the tincture and shaken up with it before mixing with water. The spirit of the tincture then tends to prevent the aggregation of the particles of the gum.

Dispense the following:—

R.	Tincturæ Benzoini Co.	...	...	3 iij.
	Tincturæ Camphoræ Compositæ			3 iss.
	Pulveris Tragacanthæ	...	...	gr. xx.
	Aquam Camphoræ	...	ad	3 vj.

How to Prescribe Effervescing Mixtures.

The usual method is to prescribe the alkaline bicarbonate in solution and the acid in powder.

Sometimes the acid is prescribed in solution and the alkali in powder, or both alkali and acid may be prescribed in separate solutions, or both as separate powders. (See *Haustus Potassii Citratis Effervescens* or *Haustus Sodii Tartratis Effervescens* of St. B. H. Ph.).

R. Potassii Bicarbonatis ... gr. xx.
 Aquæ Destillatæ ... 3 ij.

Sig. No. 1.

Acidi Citrici ... gr. xv.
 Fiat pulvis.

Sig. No. 2.

Add No. 2 to No. 1 and drink during effervescence.

The draught should be slightly acid so as to be more agreeable to the palate, therefore the acid should be slightly in excess of the amount required to saturate the alkali—14 grains of citric acid will saturate 20 grains of potassium bicarbonate.

When a drug is ordered to be given in effervescence it is added, according to its nature, to either the acid or alkaline solution or powder, *e.g.*, an alkaloidal salt is added to the acid because it is incompatible with alkalies. (See p. 51).

R. Quininæ Sulphatis ... gr. j.
 Acidi Citrici ... gr. xv.
 Aq. Destill. ... ad 3 ij.

Misce. Sig. No. 1.

Potassii Bicarbonatis ... gr. xx.

Fiat pulvis. Sig. No. 2.

Add No. 2 to No. 1 and drink during effervescence.

Lemon juice (the fresh juice of the lemon) is often used instead of citric acid. It contains about 35 grains of citric acid in a fluid ounce.

Medicine bottles are made to contain 2, 4, 6, 8, &c., ounces, not 3, 5, 7, &c.; and as bottles of medicine should be sent out *full*, prescriptions should be written for the even numbers.

Other things being equal, sulphates should be combined with sulphates, hydrochlorides with hydrochlorides, acetates with acetates, and so forth.

Dilute hydrocyanic acid tends to float on the surface of thin liquids; therefore any medicine containing it should be dispensed with a "Shake the bottle" label.

Heat is sometimes used to aid solution, *e.g.*, infusions, but it is evident that volatile substances, *e.g.*, amm. carbonate should always be dissolved and added in the cold. Volatile substances should always be added last.

When any insoluble powder, *e.g.*, magnesium carbonate, is dispensed in a mixture, it should first be rubbed up in a mortar with a little of the vehicle, and then put into the bottle; otherwise it tends to be lumpy.

All dangerous substances which are slow of solution should be completely dissolved before they are placed in the bottle.

XVII.

CHEMICAL INCOMPATIBILITY.

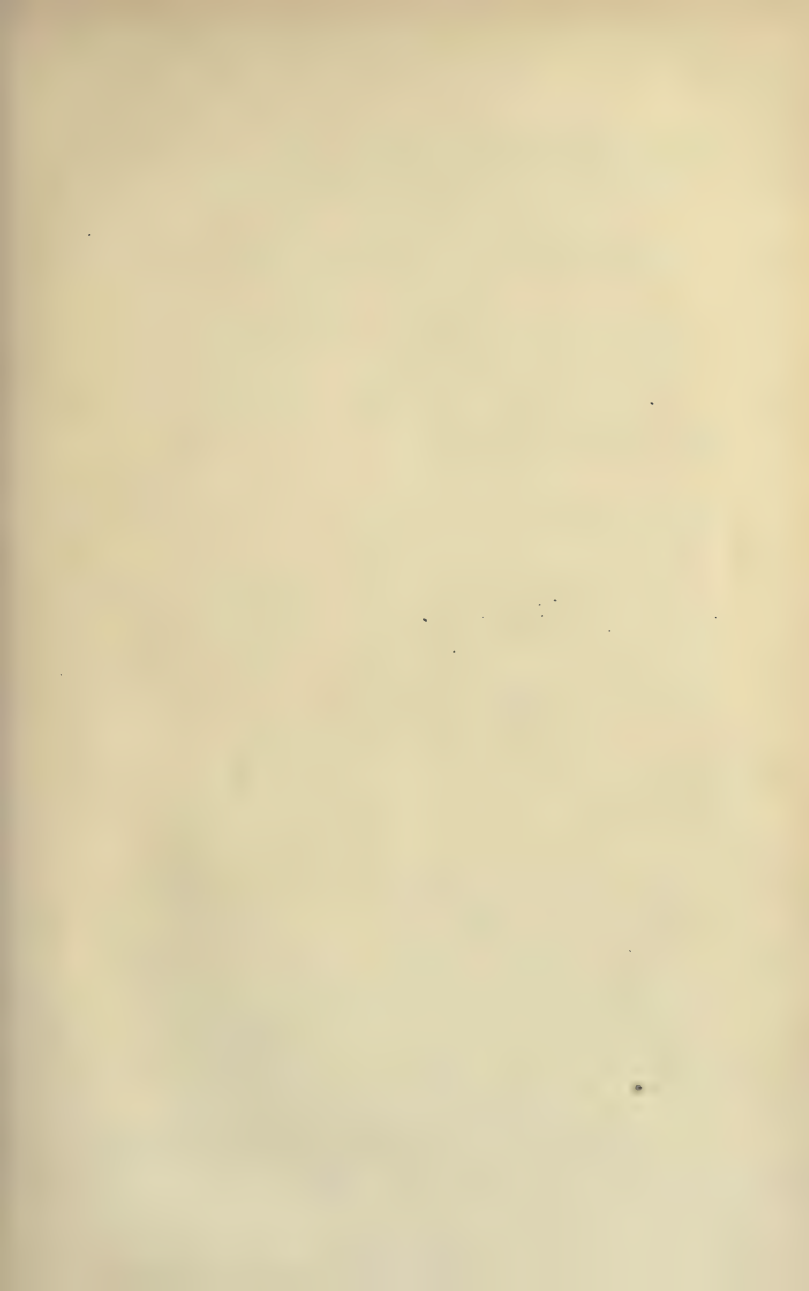
Incompatibility is of two kinds, physiological and chemical.* Physiological incompatibility is discussed in books on pharmacology. We have to do here with *chemical* incompatibility. By chemical incompatibility we mean that certain substances when mixed together react on each other in such a way that the products are useless or injurious. Generally the definition is made to include products which, although they may be neither useless nor injurious, are unsightly or disagreeable, as in the reaction between ferric salts and various kinds of tannin. Incompatibility usually depends on the production of an insoluble compound by admixture of two soluble substances. *When solutions of two soluble salts are mixed, and an insoluble compound can be formed by an interchange of radicals, this compound will, as a rule, be produced and a precipitate will occur.* In the study of this subject, therefore, it is essential in the first place to know which salts are insoluble, and it will simplify the matter to remember, in relation to bases, that the oxides and all the salts of the alkali metals are readily soluble with the exception of—

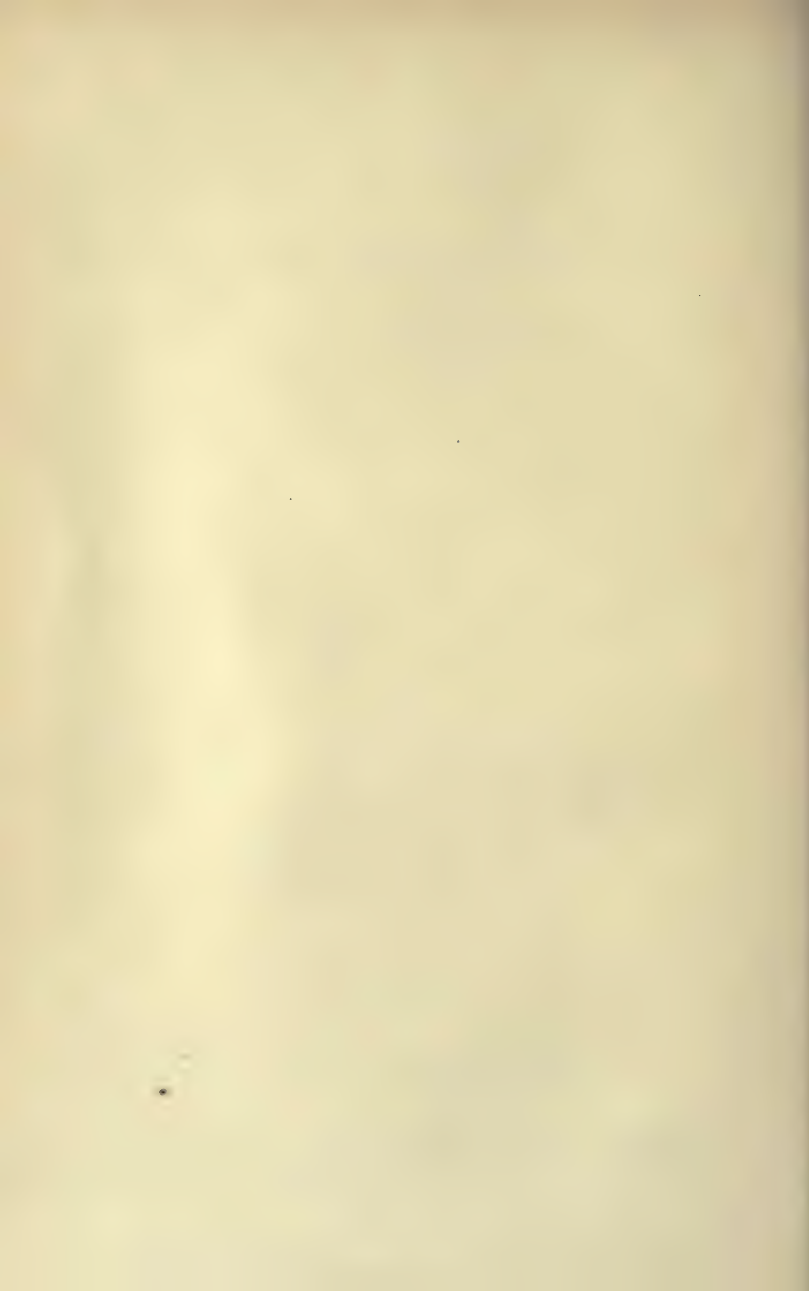
Platini-chloride of {potassium.
ammonium.

Acid tartrate of potassium.

Carbonate } of lithium are sparingly soluble ; therefore
Phosphate }

* Physical or pharmaceutical incompatibility is said to occur when substances are prescribed together which cannot be mixed by the pharmacist, *e.g.*, oils and water.





a precipitate occurs if a solution of phosphate or carbonate of the other alkalies be added to a strong solution of a soluble salt of lithium, such as the citrate.

GROUP I. Carbonates ... Insoluble, except those of alkalies.

<p>„ II. Hydroxides Oxides Sulphides *Cyanides</p>	}	<p>Insoluble, except those of alkalies and alkaline earths.</p> <p>Insoluble, except those of the alkalies and alkaline earths and mercuric.</p>
--	---	--

<p>„ III. Chlorides Bromides Iodides</p>	}	<p>Soluble, except those of mercury (proto-), silver and lead, the chlorides and bromides of antimony and bismuth, which are decomposed by water, and iodides of gold, platinum, and mercury (per-).</p>
--	---	--

<p>„ IV. Phosphates Antimonates Arsenates Arsenites</p>	}	<p>All insoluble, except those of alkalies.</p>
---	---	---

<p>„ V. Sulphates ...</p>	}	<p>Soluble, except those of alkaline earths, mercury (proto-), silver, lead, and antimony.</p>
---------------------------	---	--

<p>„ VI (a). Sulphites ...</p>	}	<p>Soluble, except the above, and aluminium, bismuth, cobalt, copper, iron (proto-), manganese, nickel, zinc, and tin (proto-).</p>
--------------------------------	---	---

* The insoluble ones are soluble in excess of potassium cyanide, of hydrocyanic acid, or other acids.

GROUP VI (<i>b</i>). Citrates. ...		Soluble, except those of alkaline earths, mercury (proto-), silver, lead, aluminium, cadmium, zinc, manganese.
„	VI (<i>c</i>). Tartrates ...	Soluble, except those of alkaline earths, mercury (proto-), mercury (per-), silver, lead, copper, zinc, nickel, cadmium, iron (proto-), manganese, antimony, bismuth.
„	VII. Oxalates ...	Insoluble, except those of the alkalies, iron (per-), iron (proto-), chromium, tin (proto-), antimony.
„	VIII. Acetates Nitrates	} Soluble.
„	IX. Nitrites	
		{ All soluble, except those of silver and lead.

It will be noticed that all the mercurous salts and salts of silver and lead are insoluble except the acetates and nitrates.

Leaving out of consideration those salts which are not likely to occur in prescriptions, the matter may fairly accurately be put in this way:—

1. The oxides and all the salts of the alkali metals are soluble in water, except the acid tartrate of potassium.
2. All acetates and nitrates are soluble in water.
3. Subject to the reservation that all mercurous salts and all salts of silver and lead—except the acetates and nitrates—are insoluble in water, and that all the bismuth salts in the presence of water form insoluble oxysalts:—

Nitrites	}	are soluble in water.
Chlorides		
Bromides		
Iodides		

Sulphates are soluble in water—except calcium.

Citrates are soluble in water. Calcium citrate, in neutral solution, is insoluble in boiling water.

Tartrates are soluble in water—except calcium tartrate which is insoluble in neutral solution.

All the other salts above mentioned and commonly used are insoluble in water.*

EXAMPLES OF GROUP I.

Carbonates.—(α) See preparation of Bismuthi Carbonas, Calcii Carbonas Præcipitatus, Magnesii Carbonas, Ferri Carbonas Saccharatus, and Mistura Ferri Co. Each process is an illustration of the fact that carbonates are insoluble except those of the alkalies.

(β) To a strong solution of citrate of lithium add some carbonate of soda.

(γ) See Note concerning Liquor Magnesii Carbonatis on p. 25.

EXAMPLES OF GROUP II.

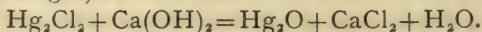
The only sulphide in the British Pharmacopœia is Calx Sulphurata, a mixture of not less than 50 per cent. CaS with CaSO₄ and C.

It is best given in pills, which should be varnished to protect them from the atmosphere and to conceal their unpleasant odour.

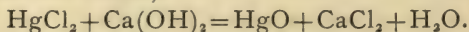
* Tannates and Gallates are generally insoluble in water. For Salicylates and Benzoates see page 71.

Oxides.—(1) Preparation of { Lotio Hydrargyri Nigra. }
 „ „ „ Flava. }

Into a test-tube (a) put a little mercurous chloride (calomel). Into a test-tube (b) put a little mercuric chloride (corrosive sublimate). Add just a little water and then some lime-water (calcium hydroxide) to each. The calomel will not dissolve in the water, but will be blackened by the lime, from formation of the suboxide (*see* Lot. Nigra).



The corrosive sublimate will dissolve in the water, and the addition of lime-water causes a yellow precipitate of oxide (*see* Lot. Flava).



(Lotio Nigra contains also glycerin* and mucilage† of tragacanth).

(2) Repeat the above experiment, using ammonia instead of lime water. The calomel will be blackened from

formation of mercurous ammonium chloride ($\text{N} \begin{smallmatrix} \text{Hg} \\ \text{H} \end{smallmatrix} \text{Cl}$).

The corrosive sublimate will give a white precipitate of

mercuric ammonium chloride ($\text{N} \begin{smallmatrix} \text{Hg}'' \\ \text{H} \end{smallmatrix} \text{Cl}$).

(3) *Cyanides*.—As hydrocyanic acid and silver nitrate are both gastric sedatives, they might possibly be put in the same prescription.

Add about m5 dilute hydrocyanic acid to about 1 dr. of distilled water. Add to this a drop of silver nitrate. A white precipitate (AgCN) falls.

* To prevent the fabric (Linen, &c.) on which it may be applied from becoming dry and adhesive.

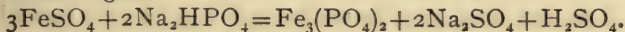
† To suspend the precipitate.

Dissolve 5 grs. of sodium bicarbonate in 1 fl. dr. of water, add a drop of solution of silver nitrate.

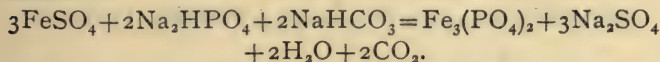
Dissolve 5 grs. sodium bicarbonate in a drachm of water. Add m5 dilute hydrocyanic acid. Shake, and then add 1 drop of silver nitrate solution. No precipitate falls, as a soluble double salt is formed, $\text{AgNa}(\text{CN})_2$.

EXAMPLES OF GROUP IV.

(1) *Preparation of Ferri Phosphas.*—Make a solution of ferrous sulphate and one of sodium phosphate. Test their reactions with litmus paper. Mix them, and test reaction again.



The free H_2SO_4 will dissolve the newly-formed phosphate of iron, therefore some sodium bicarbonate is added:—



(The precipitate ought to be washed on a calico filter till it gives no reaction with barium chloride).

See Syrupus Ferri Phosphatis, Syrupus Ferri Phosphatis c̄ Quininâ et Strychninâ. In both these syrups the drug is held in solution by phosphoric acid, so that when they are prescribed with water they tend to precipitate after a time.

Preparation of Arsenate of Iron.—This is prepared in exactly the same way as the above, dried arsenate of soda (Na_2HASO_4) being used instead of phosphate (Na_2HPO_4).

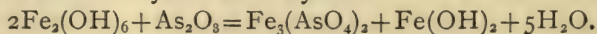
(2) *Behaviour of Iron Salts with the Acid and Alkaline Solutions of Arsenic.*—Put into two test-tubes about 2 drs. of water. Add to one about $\frac{1}{2}$ dr. of Liq. Arsenicalis, and to the other $\frac{1}{2}$ dr. of Liq. Arsenici Hydrochloricus. Then add to each a few drops of Liq. Ferri Perchlor.

Repeat, adding a few drops of a solution of Ferri et Am. Cit. or of Ferrum Tartaratum instead of Liq. Ferri Perchlor.

(3) *Antidote to Arsenical Poisoning*.—Add to 1 fl. dr. of either solution of arsenic some Liquor Ferri Perchloridi, and some sodium carbonate solution, or powdered magnesia. A reddish pasty precipitate falls. Throw on to a filter.

Put into two test-tubes 1 dr. of pure hydrochloric acid and a piece of clean copper foil. Into one put a drop or two of the filtrate, and into the other a similar quantity of the original arsenical solution. Boil. The copper will in the first case be unchanged, but in the second case will become dark.

This shows that the arsenic has been precipitated from solution by the ferric hydrate.



XVIII.

Incompatibility (*continued*).

EXAMPLES OF GROUP V.

Sulphates.—Take four test-tubes: in the first dissolve some zinc sulphate; in the second, a few grains of alum; in the third put some aromatic sulphuric acid; in the fourth, some acid infusion of roses. To each add solution of acetate of lead, and a precipitate will form.

Repeat with Liq. Calcis instead of acetate of lead.

EXAMPLES OF GROUP VI.

Tartrates and Citrates.—Tartaric is a dibasic, and citric a tribasic acid. Both tend to form double salts, which are soluble.

Tartrates and Tartarated Compounds.

Acid tartrate of potash is a very insoluble salt, but when the atom of hydrogen which it contains is replaced by a base other than potash, the *tartarated compounds* of the Pharmacopœia are formed. Thus :—

$\begin{array}{c} T'' \\ | \\ H \\ | \\ K \end{array}$	$\begin{array}{c} T'' \\ | \\ K \\ | \\ K \end{array}$	$\begin{array}{c} T'' \\ | \\ Na \\ | \\ K \end{array}$	$\begin{array}{c} T_n'' \\ | \\ K \\ | \\ Fe_m \end{array}$	$\begin{array}{c} T'' \\ | \\ K \\ | \\ SbO \end{array}$
Acid tartrate of potash.	Neutral tartrate of potash.	Tartarated soda.	Tartarated iron.	Tartarated antimony.

The neutral tartrate of potassium and the tartarated compounds are soluble in water.

PREPARATION OF TARTARATED ANTIMONY.

Mix oxide of antimony and acid tartrate of potash into a paste. (This should stand 24 hours). Boil with water; filter. Evaporate, and set aside to crystallise.

Tartar emetic is soluble 1 in 3 of boiling water and 1 in 17 of cold water.

It is precipitated (hydroxide of Sb) by alkalies or their carbonates, by tannic acid, but not by gallic acid (*see* p. 38).

Mineral acids throw down a basic chloride, nitrate, or sulphate of antimony, according to the acid used.

Citrates.

Citric acid, like tartaric acid, unites with more than one base at a time to form compounds soluble in water.

Ferri et Ammonii Citras.—The scales are much more

soluble in water than the scales of ferric citrate alone would be.

Ferri et Amm. Cit. or Ferrum Tartaratum can be prescribed in neutral or alkaline solutions.

Experiment:—(1) Dissolve a few grains of Ferri et Ammonii Citras in water and add an alkali—no precipitate. (2) Repeat with Ferrum Tartaratum—no precipitate. (3) Repeat with an ordinary iron salt, *e.g.*, Liq. Ferri Perchlor. (4) Repeat with Ferri et Quininæ Citras.

Ferri et Amm. Cit. or Ferrum Tartaratum should not be prescribed with mineral acids.

Experiment:—(1) Dissolve a few grains of Ferri et Amm. Citras in water and add a few minims of dilute hydrochloric acid—heavy precipitate. (2) Repeat with Ferrum Tartaratum.

Liquor Bismuthi et Ammonii Citratis is a solution of ammonium citrate in which three atoms of monad hydrogen are replaced by one of triad bismuth (*see* p. 85).

EXAMPLES OF GROUP VII.

Oxalates.—Take a few grains of oxalic acid and add to them some Liq. Potassæ. The crystals will dissolve. Now add to the solution some Liq. Calcis. Calcium oxalate will be precipitated. (Antidote in oxalic acid poisoning:—A calcium salt).

EFFECTS OF ACIDS AND ALKALIES OR SUBSTANCES CONTAINING THEM ON EACH OTHER.

Alkaline hydroxides and carbonates neutralise acids.

Acids decompose hydroxides and carbonates to form salts.

(1) Test the reaction of some Lin. Camph. Ammoniatum with red litmus, and that of Lin. Terebinth. Acet.

with blue litmus: mix, and test again. (The acid and alkali neutralise each other).

(2) Mix a little Hydrarg. c̄ Creta with Confect. Sulphuris.

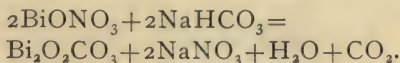
(CO₂ is given off by the action of the acid tartrate of potash on the chalk).

(3) Add some Spt. Ammon. Aromat. to Syrup Scillæ.

(The Tinctura Scillæ, not the Syrupus, should be prescribed with a carbonate because the syrup is made from the acetum, and therefore contains acetic acid).

(4) Add some Spt. Ammon. Aromat. to Syrupus Limonis. The syrup of lemons contains much fresh lemon juice and therefore a considerable amount of free citric acid. The Tinctura Limonis is made entirely from the lemon *peel*, and does not contain much acid, therefore it may be given with carbonates. Syrupus Aurantii and Tinctura Aurantii also are made entirely from the orange *peel* and therefore contain practically no acid.

(5) Mix bicarbonate of soda with subnitrate of bismuth.



(6) Add some bicarbonate of soda to some glycerin of pepsin.

(7) Dissolve some benzoate of soda in water, and add a small quantity of sulphuric acid—benzoic acid is precipitated.*

Repeat this with salicylate of soda—Salicylic acid is precipitated.†

* Benzoates are mostly soluble in water. Benzoic acid itself is insoluble in water, and is easily thrown out of solution from its salts by mineral acids. Benzoate of Quinine is insoluble in water.

† Salicylates are mostly soluble in water. Salicylic acid itself is insoluble in water, and is easily thrown out of solution from its salts by mineral acids. Salicylate of Quinine is insoluble in water.

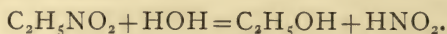
Repeat this with salicylate of soda, and acid infusion of roses.

LIBERATION OF IODINE.

By Acid.—(1) Dissolve about 5 grs. potassium iodide in about 1 dr. of water. Add one or two drops of nitric acid. A brown coloration will occur from the liberation of free iodine.

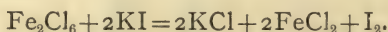
(2) Repeat this, using 1 dr. of Spt. *Ætheris Nitrosi*, instead of nitric acid.

Spiritus Ætheris Nitrosi on keeping may become acid by oxidation of aldehyde into acetic acid, or by hydrolysis of ethyl nitrite.



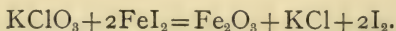
Ethyl nitrite is unstable in water, and this is why the *Liquor Ethyl Nitritis* is made with absolute alcohol and glycerin.

By Chlorine.—(1) Repeat this, using a few drops of *Liq. Ferri Perchlor.*



(2) Add to *Haustus Acidi Nitro-hydrochlorici* (St. B. H. Ph.) a few grains of iodide of potassium.

By a Strong Oxidising Agent.—Add a few grains of chlorate of potash to 1 dr. of syrup of iodide of iron, and let it stand.



On Chemical Incompatibility (*continued*).

Under the description of each drug, in books on *Materia Medica*, is given, as a rule, a long list of incompatibles. Many of these incompatibles are unimportant, and by their presence tend to obscure the important ones.



Moreover, as a rule, no reason is given why each substance is incompatible. Such lists, therefore, make little or no impression on the student.

(1) In the following pages incompatibilities between drugs which are never likely to be prescribed together will be neglected, and as to those drugs which are likely to be given in combination, incompatibilities will be pointed out only if they are important, and in each case the reason of the incompatibility will be given.

It will be taken for granted that no one would, in ignorance, combine a free acid and a carbonate, and it is evident that *a drug should never be prescribed in combination with its tests or antidotes.*

(2) Most examples of chemical incompatibility come under the rule already enunciated, viz.:—" *When solutions of two soluble salts are mixed and an insoluble compound can be formed by their interaction, this compound as a rule will be formed and a precipitate will occur. Sometimes no precipitate takes place because a soluble double salt is formed.*" Therefore it is evident that a student cannot have any *independent* prescribing power whatever, unless he has learnt which salts, at least of the commoner ones, are insoluble (*see p. 64*). In future the incompatibilities coming under this rule will often be taken for granted.

(3) The following important drugs are incompatible with so many things that in solution they are best given either alone, or in some simple mixture learnt by heart, which experience has shown to be satisfactory.

Lead salts (the acetate is the only one used internally).

Mercuric chloride.

Silver nitrate, this is now practically never given internally in solution.

Tannic acid.

Gallic acid.

Tartar emetic.

Oxydising agents such as potassium chlorate, potassium permanganate.

Phenazonum (antipyrin).

However, the chief incompatibilities of most of these drugs will be noticed under their respective headings.

Mucilago Acaciæ.

(1) Precipitated by alcohol (*see* p. 35).

Tinctures and other alcoholic preparations are, of course, prescribed in emulsions made with gum acacia, but, as a rule, the mucilage being much diluted with water and the amount of alcohol present being small no precipitate occurs—nevertheless *see* Caution on p. 58.

(2) Precipitated by a concentrated solution of borax (*see* p. 35).

(3) Precipitated by persalts of iron (*see* p. 35).

The Tinctura Ferri Perchlor. is more effective than the Liquor because of the alcohol in it.

In a prescription the dose of any of these drugs is small, and the mucilage is much diluted with water so that precipitation need not take place—the incompatibility is theoretical rather than practical.

(4) Precipitated by subacetate of lead (*see* p. 35), even though both mucilage and subacetate be well diluted.

Mucilage of tragacanth is thickened by alcohol (not in dilute solutions) but is not precipitated by borax nor by ferric salts.

Acidum Gallicum.

Gallates of the alkalies are soluble in water, all the others are insoluble.

Therefore gallic acid is incompatible with metallic salts generally, especially with iron salts (*see* p. 38).

It does not precipitate alkaloids and is frequently prescribed with preparations of opium.

Acidum Hydrocyanicum Dilutum.

(1) It does not decompose carbonates—it is therefore often very properly prescribed with bicarbonate of soda as a gastric sedative and antacid :—

R̄.	Sodii Bicarbonatis	...	...	gr. x.
	Acidi Hydrocyanici Dil.	...	...	℥ iv.
	Tinct. Card. Co.	...	...	℥ x.
	Aq. Destill.	...	...	ad ʒ j.

Dilute hydrocyanic acid contains a little hydrochloric acid to preserve it, this may cause a slight effervescence. It decomposes more quickly in alkaline solutions.

Only the cyanides of the alkalies, and of the alkaline earths and mercuric cyanide are soluble in water, therefore the drug is incompatible with most metallic salts though any insoluble cyanide can form a soluble double salt in presence of an alkali cyanide (*see* p. 67).

(2) Dilute hydrocyanic acid is much used as a sedative to sensory nerve endings in the stomach, and is apt to be given in combination with morphine.

If morphine and hydrocyanic acid were brought together in concentrated solution, a cyanide of morphine would be precipitated, but there is no fear of this happening in a prescription because very small quantities are present and in very dilute solution, *e.g.* :—

R̄.	Liq. Morphinae Hydroch.	...	...	℥ x.
	Acidi Hydrocyanici Dil.	...	...	℥ iv.
	Tinct. Card. Co.	...	...	℥ xv.
	Aq. Destill.	...	...	ad ʒ j.

No precipitate will take place.

(3) It is often added to iron salts to correct their irritant action on the stomach:—

R̄.	Ferri et Amm. Cit.	...	...	gr. v.
	Acidi Hydrocyanici Dil.	...	...	℥ iv.
	Sp. Chloroformi	...	...	℥ xv.
	Aq. Destill.	...	...	ad ʒ j.

If this prescription were made alkaline it might lead to the formation of some ferrocyanide—but it is not at all likely to do so because the amount of hydrocyanic acid is so small and in so dilute a solution.

Acidum Tannicum.

- (1) Precipitates alkaloids (*see* Alkaloids).
- (2) Precipitates iron salts (*see* p. 38 and Iron Salts).
- (3) Precipitates tartar emetic (*see* p. 38 and Antimony Tartaratum).
- (4) Precipitates metallic salts generally.
- (5) Incompatible with mineral acids, many mineral acids and salts precipitate tannic acid by a process resembling that of salting out of soap.
- (6) With alkalies tannic acid forms soluble tannates, but in a short time the solution changes colour becoming even black.

See p. 73, paragraph (3).

Alkaloids.

(α) Alkaloids are precipitated by tannic acid and by all substances containing it.

Example:—

R̄.	Quininæ Sulphatis	...	...	gr. j.
	Acidi Sulphurici Diluti	...	...	℥ j.
	Infusum Rosæ Acidum	ad	ʒ j.	

This infusion is made with sulphuric acid, and therefore it seems very natural to prescribe it with *sulphate* of quinine, but a precipitate of Tannate of Quinine is formed.

Dispensers have been known to filter off the precipitate and to send out the medicine without it !

(β) Alkaloids are precipitated in alkaline solutions.

Example :—

(1) \mathcal{R} . Quininæ Sulphatis ... gr. j.
 Acidi Sulphurici Diluti ... ℥ j.
 Spiritus Ammoniæ Aromatici ℥ xv.
 Aquam Destillatam ... ʒ j.

The quinine will, of course, be precipitated by the alkaline spiritus, which also contains Ammonium Carbonate, so that any free acid will cause effervescence.

(2) \mathcal{R} . Ferri et Quininæ Citratis ... gr. v.
 Spiritus Ammoniæ Aromatici ℥ xv.
 Aquam Destillatam ... ad ʒ j.

This is a combination often seen in prescriptions, probably due to the mistaken generalisation that the scale preparations of iron—*e.g.*, the Ferri et Ammonii Citras—are not precipitated by alkalies, but the *alkaloid* will be precipitated.

The Tinctura Quininæ Ammoniata is a solution of Quinine Hydroxide in alcohol and in excess of ammonia. When water is added the alkaloid is precipitated. The tincture, therefore, should always be prescribed with mucilage. Quinine precipitated in a mixture is not so bitter as when in solution.

Borax (Biborate of Sodium) is alkaline, and therefore precipitates alkaloids (*see* Cocaine).

If the amount of alkaloid in a prescription be small, or if the alkali be weak, *e.g.*, Sodii Bicarb., or Pot.

Bicarb.—very often no reaction will take place.

And *see* Atropine, Caffeine.

(γ) Alkaloids are precipitated by iodine and iodides (except caffeine):—

- (1) R. Potassi Iodidi gr. v.
 Ferri et Quininæ Citratis ... gr. v.
 Aquæ Destillatæ ʒ j.

Potassium Iodide will not precipitate the quinine in neutral solution. Ferri et Quininæ Citras is generally sufficiently acid for the purpose, but if no precipitate, add a drop of dilute acid so as to free some iodine, and the alkaloid will be precipitated at once (*see* p. 51, Wagner's reagent).

- (2) R. Quininæ Sulphatis gr. j.
 Acidi Sulphurici Diluti ... m j.
 Potassii Iodidi gr. v.
 Aquam Destillatam ... ad ʒ j.

This is the *Haustus Quininæ c̄ Pot. Iod.* of the *St. B. H. Pharmacopœia*. On the face of it the prescription looks impossible because of the presence of the alkaloid and of free acid with Potassium Iodide. But the mixture can be dispensed successfully in the following manner:—

Dissolve the quinine sulphate in the smallest possible amount of acid ($m \frac{3}{4}$ to each grain) so as to have the smallest possible amount of free acid present, then dilute the solution with half the vehicle.

The Potassium Iodide is dissolved in the other half of the vehicle, and, having thus diluted the two salts to the utmost, bring them together.

If excess of acid be used, or if the two salts be brought together in stronger solution, reaction will be inevitable.

(3) Double Iodides, *e.g.*, Liq. Arsenii et Hydrargyri Iodidi precipitate alkaloids at once.

R. Liq. Strychninæ Hydroch. ... ℥ x.
 Haust. Hydrarg. Perchlor. ē
 Pot. Iod. (St. B. H. Ph.) ad ʒ j.

Iodide of Morphine is thrown down.

This Haustus is practically Mayer's reagent (*see* page 51 and 89).

(δ) Some alkaloids are precipitated by *Bromine* and *Bromides*, but they are less likely to be so than with Iodine and Iodides.

R. Strychninæ Hydrochloridi ... gr. $\frac{1}{10}$.
 Potassii Bromidi ... gr. xx.
 Aquæ Destillatæ ... ʒ j.

This mixture may be clear at first, but presently it tends to deposit crystals of bromide of strychnine.

Quinine goes very well with Bromides, because the hydrobromide of quinine is very soluble in water. Dilute hydrobromic acid is an excellent solvent of the quinine salts, and tends to prevent the headache and ringing in the ears they may cause.

(ε) Alkaloids form a dense precipitate with the Ext. Glycyrrhizæ Liq.*

(ζ) Most organic acids, except acetic and citric acids, form insoluble salts with most alkaloids.

See also the individual alkaloids.

Liquor Ammonii Acetatis.

Generally alkaline.

(1) Acids will decompose it, setting free acetic acid.

* Liquid extracts generally precipitate heavily when added to water, thus making very inelegant mixtures.

R.	Liq. Ammonii Acetatis	...	...	$\frac{3}{4}$ ss.
	Acidi Sulph. Dil.	...	...	℥ x.
	Aq. Destill.	...	...	ad $\frac{3}{4}$ j.

Smell the acetic acid given off.

(2) Potassium or Sodium Carbonate or Bicarbonate will decompose *any* ammonium salt, setting free Ammonia.

R.	Liq. Amm. Acet.	...	...	$\frac{3}{4}$ ss.
	Pot. Carb.	...	...	gr. x.
	Aq. Destill.	...	...	ad $\frac{3}{4}$ j.

Smell the ammonia given off.

(3) With the ordinary salts of iron it will throw down the hydrate of iron unless its alkalinity be neutralised by a few drops of dilute acetic acid. It is often prescribed with Tinct. Ferri Perchlor., in order to produce a red solution of ferric acetate (*e.g.*, in Chronic Parenchymatous Nephritis).

R.	Tinct. Ferri Perchlor.	...	...	℥ x.
	(Acidi Acetici Dil.	...	...	℥ v.)
	Liq. Amm. Acet.	...	...	$\frac{3}{4}$ ss.
	Aq. Destill.	...	...	ad $\frac{3}{4}$ j.

Without the dilute acetic acid ferric hydrate will probably be thrown down.

(4) It is often prescribed with quinine (*see* Quinine).

Ammonii Benzoas.

(1) Acids will turn out the benzoic acid, which being insoluble, will precipitate.

(2) Benzoates are mostly soluble, but with ferric salts an insoluble flesh coloured ferric benzoate is formed. They are similarly incompatible with lead, mercury and silver salts.

(3) Most alkaloids form insoluble benzoates. Benzoate of quinine is the one best known.

(4) *See* Liq. Amm. Acet. (2).

Ammonii Bromidum.

(1) *See* Bromides.

(2) *See* Liq. Amm. Acet. (2).

Ammonii Carbonas.

(1) Incompatible with acids.

(2) Being alkaline it is incompatible with alkaloids,* ordinary iron salts, mercuric chloride, and other substances which cannot be given in alkaline solution.

(3) And being a carbonate it is unnecessary to say that it will form insoluble salts with all metals except the alkalies.

(4) *See* Liq. Amm. Acet. (2).

Antimonium Tartaratum.

See p. 73, paragraph (3).

(1) Acids will precipitate, with some acid tartrate of potash, a basic chloride, nitrate, sulphate, according to the acid used.

(2) Alkalies, unless the solutions are too weak, will precipitate hydroxide of antimony.

(3) Tannic acid precipitates tannate of antimony (*see* p. 38).

(4) The salts of most metals are incompatible with tartar emetic.

The above are the chief incompatibles, but their enumeration is scarcely worth while, because nowadays the drug is scarcely ever used, at least in a mixture,

* It does not precipitate from solution :—Atropine, Hyoscyamine, Codeine, Caffeine.

except as an expectorant in the early stages of bronchitis to render the phlegm less tenacious.

Ipecacuanha, alkalies and potassium iodide, also render phlegm less tenacious, so that Vinum Antimoniale is often prescribed with these :—

Example :—

Vini Antimonialis	...	...	℥ x.
Vini Ipecac.	...	...	℥ x.
Sodii Bicarb.	...	...	gr. x.
Potassii Iodidi	...	...	gr. v.
Aq. Menth. Pip....	...	ad	℥ j.

The amount of alkali is far too small to precipitate any hydroxide of antimony.

Antipyrin.

Antipyrin is incompatible with so many substances that it is eminently a drug to prescribe by itself, or in some combination learnt by heart which experience has shown to be satisfactory.

Argenti Nitras.

It is incompatible with so many substances that it is eminently a drug to give by itself.

In these days it is seldom given internally.

Arsenic.

(1) Liq. Arsenicalis, being alkaline, tends to precipitate the ordinary preparations of iron (*see* p. 67), therefore it is generally prescribed with Ferri et Am. Cit. or with Ferrum Tartaratum, which are not precipitated by an alkali.

Example :—

Liquoris Arsenicalis	...	...	℥ iv.
Ferri et Ammonii Citratis	...	...	gr. v.
Spiritus Ammoniaë Aromatici			℥ x.
Aquam Destillatam	...	ad	℥ j.

Yet we often see prescriptions such as this :—

Liq. Arsenicalis	...	...	℥ iv.
Liq. Ferri Perchlor.	...	...	℥ x.
Sp. Chloroformi	...	...	℥ xv.
Aq. Dest.	...	ad	℥ j.

Theoretically, the alkaline Liq. Arsenicalis should precipitate the iron, but no precipitate takes place, because the iron solution contains so much free acid that the resultant mixture is still *acid*.

(2) Liq. Arsenici Hydrochloricus, being acid, can be given very properly with the ordinary preparations of iron ; it was put into the B.P. for the purpose.

Evidently also the acid solution of arsenic should be chosen to combine with alkaloids, for example, with strychnine or with quinine, or the cinchona preparations.

Example :—

Liq. Arsenici Hydrochlorici	...	℥ iv.
Liq. Strychninaë Hydroch.	...	℥ iv.
Tinct. Ferri Perchlor...	...	℥ x.
Infusum Quassiaë	...	ad ℥ j.

People have died from the prescription of Liq. Arsenicalis with Liq. Strychninaë Hydrochlor., the alkali precipitating the alkaloid to the bottom of the bottle, so that the patient has taken the whole of the poison in one dose.

Liq. Sodii Arsenatis is generally alkaline, and therefore tends to precipitate alkaloids or ordinary iron salts,

whilst Donovan's solution Liq. Arsenii et Hydrargyri Iodidi is, of course, a typical precipitant of alkaloids (*see* Alkaloids).

(3) Again, the acid solution should be used with Liq. Hydrarg. Perchlor., because alkalies will throw down mercuric oxide.

Liq. Arsenicalis, however, is sometimes added to the Haustus Hydrarg. Perchlor. c̄ Pot. Iod. of the St. B. H. Ph. to prevent the appearance of iodism, but this mixture really contains a double *iodide* of mercury and potassium, with which alkalies and not acids are properly prescribed (*see* Iodides).

Atropine.

Incompatible with the usual alkaloidal precipitants (*see* Alkaloids), except that it is precipitated only from *concentrated* aqueous solutions of its salts, by the hydrates and carbonates of the fixed alkalies, and not at all by the bicarbonates nor by Amm. Carbonate. This applies also to Hyoscyamine.

Example :—

R̄.	Tinct. Bellad.	...	...	...	℥ x.
	Pot. Brom.	...	...	...	gr. x.
	Sp. Amm. Aromat.	...	...	...	℥ xxx.
	Aq. Destill.	...	...	ad	℥ j.

No precipitate will occur.

Bismuth.

The bismuth salts being insoluble in water are generally, but not necessarily, prescribed with mucilage.

(1) A combination of the subnitrate with bicarbonate of soda is in many of the London Hospitals' Pharmacopœias :—

Rx.	Bismuthi Subnitrat	...	...	gr. viij.
	Sodii Bicarbonatis	...	...	gr. viij.
	Infusi Calumbæ	...	...	℥j.

For the reaction between the two salts, *see* p. 71. It is generally dispensed in this way:—The two salts are mixed in a mortar with a little *hot* water, and when all the CO₂ is given off—the process is much accelerated by the heat—the mixture is placed in the bottle. This process at least neutralises the free acid which is developed when subnitrate of bismuth is suspended in water and which tends to clot any mucilage that may be added.

It is better, of course, to prescribe the carbonate of bismuth with the bicarb. of soda, thus avoiding any interaction.

(2) Moreover, seeing that the subnitrate suspended in water renders the water acid, the drug evidently should not be prescribed with substances which cannot be given in acid solution.

Example:—

Rx.	Bismuthi Subnit.	...	...	gr. x.
	Potassii Iodidi	...	...	gr. v.
	Aq. Destill.	...	...	℥j.

In a few minutes the mixture turns yellow from free iodine and from formation of an iodide of bismuth.

(3) The Liquor Bismuthi et Ammonii Citratis should not be prescribed with alkalies or their carbonates lest a precipitate of bismuth hydroxide or carbonate presently take place.

(4) The Liq. Bism. et Am. Cit. is precipitated at once by mineral acids.

R.	Liq. Bism. et Am. Cit.	...	...	℥ xxx.
	Acid. Sulph. dil.	...	...	℥ x.
	Aq. Destill.	...	...	ad ʒ j.

Citrate of bismuth is thrown down.

(5) Bismuth cannot be prescribed with anything containing tannin because the tannate of bismuth is insoluble (*see* p. 38).

Bismuth prescriptions have often been made up with Inf. Rhei to counteract the constipating effect of bismuth.

R.	Liq. Bism. et Am. Cit.	...	...	℥ xxx.
	Tinct. Card. Co.	...	...	℥ xv.
	Inf. Rhei	...	...	ad ʒ j.

Tannate of bismuth will be formed.

Borax.

(1) *See* Acacia.

(2) *See* Alkaloids and Cocaine.

Being alkaline it should not be prescribed with acids.

Bromides.

Bromides on the whole react similarly to iodides but they are much less sensitive as a rule (*see* Iodides).

Caffeine.

(1) Incompatible with the usual alkaloidal precipitants (*see* Alkaloids), except that it gives no precipitate with Mayer's reagent, nor any with Wagner's reagent (*see* p. 51).

Nor does it readily precipitate from its salts on the addition of an alkaline substance—this is because the alkaloid itself is so much more soluble in water (1 in 80) than most alkaloids.

(2) Sodium salicylate renders caffeine much more soluble in water (*see* p. 12, and Sodium Salicylate).

(3) Citrate of caffeine is acid and when dissolved in water yields an acid solution. Moreover, in water it easily dissociates—freeing citric acid. Therefore it is incompatible with those substances which cannot be given in acid solution, *e.g.* :—

R. Caffeinæ Citratis	...	...	gr. v.
Potassii Iodidi	...	...	gr. v.
Aq. Destill.	...	...	3 j.
Iodine will be set free.			

Chloral Hydrate.

(1) When chloral hydrate is prescribed with alkalies chloroform separates out.

Example :—

R. Chloral Hydratis	...	...	gr. x.
Potassii Bromidi	...	...	gr. xx.
Ammonii Carbonatis	...	...	gr. v.
Aquam Destill. ...	...	ad	3 j.

(2) With potassium iodide in aqueous solution iodine and chloroform are slowly evolved.

(3) It should not be prescribed in water with phenazonum (antipyrin) nor with any other of the solids with which it forms an oily liquid. The oily liquid deposits at the bottom of the bottle.

Cocaine.

(1) Precipitated by the usual alkaloidal reagents (*see* Alkaloids).

Cocaine is a local anæsthetic and therefore is often added to sedative lotions.

A usual sedative lotion is Lotio Boracis (St. B. H. Ph.).

Cocaine added to this lotion will be precipitated by the alkaline borax, but it will go very well with Lotio Acidi Boraci (St. B. H. Ph.).

Boric acid is also often associated with cocaine for application to the conjunctival mucous membrane (Guttæ).

R.	Cocainæ Hydroch.	...	...	gr. viij.
	Acidi Boraci	...	...	gr. v.
	Aq. Destill.	...	...	℥ j.

But the following prescription being alkaline would be incompatible.

R.	Cocainæ Hydroch.	...	...	gr. v.
	Boracis	...	...	gr. ij.
	Aq. Destill.	...	...	℥ j.

Glycerin splits up borax into sodium metaborate and boric acid. Therefore glycerin tends to prevent the precipitation of cocaine by borax.

Digitalis.

(1) The preparations of digitalis contain some tannin, and are therefore said to be incompatible with iron salts. But they are frequently given together quite satisfactorily.

Example :—

R.	Tincturæ Digitalis	...	...	℥ x.
	Liquoris Ferri Perchloridi	...	...	℥ xv.
	Spiritus Chloroformi	...	...	℥ xv.
	Aquam Destillatam	...	ad	℥ j.

The mixture will turn green and slightly muddy, from the tannate of iron formed. The addition of Acidi Phosphorici Dil. ℥ x. will make the mixture clear and replace the green colour by light yellow—for the tannate of iron is substituted a phosphate of iron soluble in excess of the

phosphoric acid or of the free hydrochloric acid of the Liquor.

The addition of dilute phosphoric acid no doubt makes a more agreeable looking mixture, but it also renders the mixture more acid and this is not good for the patient's teeth and stomach.

(2) And for the same reason they are incompatible with alkaloids—but they are often given with alkaloids.

Example:—

R̄. Tinct. Digitalis	...	...	℥ x.
Ferri et Quin. Cit.	...	...	gr. v.
Syr. Limonis	...	...	℥ xxx.
Aq. Destill.	...	...	ad ʒ j.

Tannate of quinine will be precipitated.

Both the above prescriptions should be dispensed with a "Shake the bottle" label.

Hydrargyri Perchloridum.

Incompatible with:—

(1) Alkalies, e.g., Lotio Flava, Lotio Nigra, Hydrargyrum Ammoniatum.

(2) A soluble iodide with Hydrag. Perchlor. precipitates mercuric iodide soluble in excess (forming a double iodide) of either reagent.

Example:—

R̄. Potassii Iodidi...	...	...	gr. v.
Liquoris Hydrargyri Perchloridi	ʒ j.		
Aquam Chloroformi	...	ad	ʒ j.

Dissolve the iodide in the aqua and add a few drops of the Liq. Hyd. Perchlor.; a precipitate of the red iodide of mercury occurs, but as the precipitate descends in the solution it becomes redissolved because the red iodide, insoluble in water, is freely soluble in a solution

of Potassium Iodide—a double soluble salt, the Iodide of Potassium and of Mercury, is formed.

See the *Haustus Hydrargyri Perchloridi c̄ Potassii Iodido* of the St. B. H. Ph. (practically Mayer's reagent, see Alkaloids).

See page 73, paragraph (3).

Iodides.

(α) Cannot be prescribed in acid solution, because the acid will turn out the iodine.

Example:—

(1) R. Liquoris Ferri Perchloridi ... ℥xv.
 Potassii Iodidi ... gr. v.
 Aquam Destillatam ... ad 3j.

The Liq. Ferri Perchlor. contains a good deal of free hydrochloric acid. The mixture will contain free iodine.

Moreover, quite apart from any free acid, the Perchloride itself will turn out the iodine (see p. 72).

But it is often useful to combine iron and iodide; in the St. B. H. Pharmacopœia the *Ferrum Tartaratum* is used (see *Hst. Ferri et Pot. Iodidi*), or it can be prescribed with *Ferri et Am. Cit.*

Of course, there is also the *Syr. Ferri Iodidi*.

(2) R. Potassii Iodidi ... gr. v.
 Spiritus Ætheris Nitrosi ... 3j.
 Aq. Destillatam ... ad 3j.

Many specimens of *Sp. Æth. Nit.* are acid, therefore, in the above prescription it is desirable to add some alkali, e.g., *Pot. Bicarbonas* (see p. 94).

But the mixture should not be made distinctly alkaline, because alkalies quickly decompose the ethyl nitrite to form alcohol and a nitrite of the base.

It is usual in dispensaries to keep a few crystals of

Pot. Bicarb. in the Sp. Æth. Nit. bottle so as to maintain neutrality.

See also Caffeinæ Citras and Bismuth.

(β) Iodides precipitate alkaloids (see Alkaloids, p. 76).

(γ) Iodide in presence of a strong oxidising agent:—

R.	Potassii Chloratis	...	...	gr. v.
	Syrupi Ferri Iodidi	...	...	3 j.
	Spiritus Chloroformi	...	...	℥ xv.
	Aquam Destillatam	...	ad	3 j.

Ferric hydroxide will be precipitated and iodine set free (see page 72).

Iron Salts.

(1) The ordinary preparations of iron are thrown down by alkalies. Ferri et Ammon. Cit. and Ferrum Tartaratum are not precipitated by alkalies.

Example:—

R.	Ferri et Ammonii Citratis	...	gr. v.
	Spiritus Ammoniaë Aromatici	...	℥ xv.
	Infusum Quassiaë	...	ad 3 j.

The solution will not be quite clear because the volatile oils in the Spiritus precipitate on the addition of water. If Ammonium Carbonate gr. v. be used instead the solution will be clear.

See also the Haustus Ferri Alkalinus, the Haustus Ferri et Amm. Cit. of the St. B. H. Ph.

(2) Note, moreover, that salts of iron can be prescribed only with two of the infusions of the B. P., viz., those of Quassia and Calumba, because these two infusions contain no tannin. If the Infusum Rhei were used in the above prescription a copious precipitate of tannate of iron would be thrown down.

(3) Iron salts are also incompatible with gallic acid (*see* p. 38).

(4) Syr. Ferri Phosph.

Syr. Ferri Phosph. c̄ Quininâ et Strychninâ. (*See* p. 67).

(5) Syr. Ferri Iodidi is a very unstable neutral solution which readily absorbs oxygen, precipitates a red oxy-iodide, and finally iodine is set free—the sugar restrains the oxidation to some extent. Thus even when prescribed alone in water it tends to precipitate, and if prescribed in a distinctly acid solution iodine will be set free, and if in an alkaline solution the iron will be thrown down. Ordinary tap water may be sufficiently alkaline to precipitate it.

See also Acacia, Arsenic, Digitalis, Liq. Amm. Acetatis, Iodides, Sodium Salicylate, &c.

Magnesii Sulphas.

(1) The fixed alkalies and their carbonates with Magnesium Sulphate precipitate Magnesia and Mag. Carbonate respectively, but Liq. Ammoniā and Ammonium Carbonate scarcely precipitate at all with Mag. Sulphate, and are therefore not incompatible (*see* *Mistura Sennæ Co. B. P.*).

Moreover, Magnesium Sulphate is not incompatible with the Bicarbonates of Potassium and Sodium.

R̄.	Magnesii Sulphatis	...	...	3 j.
	Sodii Carbonatis	...	...	gr. x.
	Syr. Aurantii	...	...	3 j.
	Aq. Destill.	...	ad	3 j.

Magnesium Carbonate is precipitated.

R.	Magnesii Sulphatis	...	...	3 j.
	Sodii Bicarb.	...	...	gr. x.
	Syr. Aurantii	...	...	3 j.
	Aq. Destill.	...	ad	3 j.

No precipitate occurs.

See Note on p. 25 concerning Liquor Magnesii Carbonatis.

Morphine.

Incompatible with the usual alkaloidal precipitants, (see Alkaloids).

Nitrites.

Nitrites in aqueous solution easily hydrolyse with the formation of nitrous acid.

Spiritus Ætheris Nitrosi.—Specimens are often acid to begin with, from hydrolysis of the ethyl nitrite, or from the conversion of aldehyde into acetic acid, or if neutral when added to a mixture, the solution may soon become acid.



(a) Such acid specimens:—

(1) With carbonates cause effervescence.

(2) With tannic acid (or gallic) gaseous compounds of nitrogen are evolved.

Incompatible, therefore, with all drugs containing tannin.

(3) With iodides—see Iodides.

(4) With sodium salicylate—see Sodium Salicylate.

(5) With Liquor Amm. Acetatis.

R.	Sp. Ætheris Nitrosi	...	...	3 j.
	Liq. Ammon. Acetatis	...	...	3 ss.
	Aq. Destill.	...	ad	3 j.

This is a very usual febrifuge, any nitrous acid present combines with the ammonia to form ammonium nitrite, which is active, though not so active as ethyl nitrite—so that the mixture is not really incompatible.

The above reactions may be prevented or at least hindered by adding to the Spiritus sufficient Pot. Bicarb., to neutralise any acidity, but excess of alkali should be avoided, because alkalies at once decompose ethyl nitrite to form alcohol and a nitrite of the base used.

(b) Alkalies hasten the hydrolysis of Sp. *Ætheris Nitrosi*—see above.

(c) Acids also decompose nitrites.

(d) It gives a yellow colour with morphine.

„ „ green colour with antipyrin.

„ „ yellow colour with acetanilide.

„ „ blue to red colour with guaiac.

„ „ yellow to red colour with carbolic acid.

But these colour reactions are of minor importance. The other nitrites react similarly to Sp. *Æth. Nitrosi*.

Liquor Trinitrini is a solution of nitroglycerin in 90 per cent. alcohol—the addition of a little more than an equal quantity of water renders it milky from precipitation of the nitroglycerin, which is very sparingly soluble in water.

But as it is sparingly soluble in water the usual dose of Liq. Trinitrini (℥ j.) will be dissolved in a prescription made up with an ounce of water.

Nux Vomica.

See Strychnine.

Opium.

See Morphine, Plumbi Acetas.

Physostigmine.

Incompatible with the usual alkaloidal precipitants
(see Alkaloids.)

Pilocarpin.

Incompatible with the usual alkaloidal precipitants
(see Alkaloids.)

Plumbi Acetas.

(1) All the salts of lead, except the acetate, sub-acetate, nitrate and nitrite, being insoluble in water, lead acetate is incompatible with chlorides, bromides, iodides, cyanides, carbonates, sulphates, phosphates, salicylates, benzoates, citrates, tartrates, &c.

(2) With a solution containing opium it forms soluble acetates with the alkaloids and precipitates insoluble meconate and sulphate of lead.

(3) With tannic acid or anything containing it, *e.g.*, infusions except those of calumba and quassia, tannate of lead is thrown down.

See page 73, paragraph (3).

Examples:—

(1) R.	Acidi Sulphurici Diluti	...	℥ x.
	Plumbi Acetatis	...	gr. v.
	Aquam Destillatam	ad	℥ j.

Lead sulphate is precipitated.

It is advisable, where possible, to make up prescriptions with distilled water: for example, lead acetate with hard water (that is, water containing a quantity of carbonate and sulphate of lime) will precipitate carbonate and sulphate of lead.

(2) R.	Plumbi Acetatis	...	...	gr. v.
	Tinct. Opii	...	...	℥ x.
	Aquam Destillatam		ad	℥ j.

Insoluble meconate of lead is precipitated.

R.	Plumbi Acetatis	...	...	gr. v.
	Liquoris Morphinae Acetatis			℥ xv.
	Aquam Destillatam		ad	℥ j.

Here you have the active principle of opium without any meconic acid, and no precipitate occurs.

Lead acetate can, of course, be given with opium in the solid form, *e.g.*, Pil. Plumbi c̄ Opio and Suppositoria Plumbi Co. of the B.P.

Moreover, liquid preparations of opium are often combined with lead acetate or subacetate for *external* use as a sedative lotion—here a precipitate is not important.

For example, the following incompatibles are intentionally prescribed together, *e.g.*:—

R.	Zinci Sulphatis	...	...	gr. ij.
	Plumbi Acetatis	...	...	gr. iv.
	Extracti Opii Liquidum		...	℥ j.
	Aquam ...	...	ad	℥ iij.

Fiat lotio.

In this lotion sulphate and meconate of lead are purposely thrown down for their mechanical action on the part.

(This lotion *being intended for external use only* must be dispensed into a bottle which is distinctive to touch as well as to sight, *e.g.*, a green or blue bottle of corrugated glass. And it must be labelled "Poison: for external use only," also it must evidently bear a second label—"Shake the bottle.")

Liquor Plumbi Subacetatis.

Incompatibilities are those of Lead Acetate, it also precipitates Mucilage of Acacia (*see* p. 74).

Quinine.

Incompatible with the usual alkaloidal precipitants—*see* Alkaloids.

Sulphate of Quinine is very sparingly soluble in water (1 in 740), but if a little dilute sulphuric acid be added, solution rapidly takes place, because the bisulphate, which is soluble (1 in 5), has been formed.

Now if an acetate (*e.g.*, Liq. Amm. Acetatis, Pot. Acetate) be added to a solution in water of the bisulphate, a precipitate of Quinine Acetate tends to take place, because this salt is so much less soluble (1 in 600) than the bisulphate. Similarly a precipitate tends to take place if a solution of an arsenate, or an arsenite, or a phosphate, or a citrate, or a tartrate, or a benzoate, or a salicylate, be added to a soluble quinine salt, because the salt which would be formed is very sparingly soluble in water. Liq. Amm. Acetatis is generally alkaline, and if it should render alkaline a mixture containing quinine, the hydrate of quinine, not the acetate, would of course be precipitated.

Example:—

R.	Quininæ Sulphatis	...	...	gr. ij.
	Acidi Sulph. Dil.	...	...	℥ iij.
	Potassii Acetatis	...	...	gr. x.
	Aq. Destill.	...	ad	℥ j.

The mixture is acid and in a few minutes Quinine Acetate is precipitated freely.

See also *Haustus Sodii Salicylatis et Quininæ* (St. B. H. Ph.).

Sodium Salicylate.

(1) Sodium salicylate cannot be prescribed in acid solution (*see* p. 17).

Example:—

Sodii Salicylatis	...	...	gr. x.
Acidi Sulphurici Diluti	...	...	℥ x.
Spiritus Chloroformi	...	...	℥ xv.
Aquam Destillatam	...	ad	℥ j.

The salicylic acid will be liberated, and, being insoluble, it will be precipitated.

The *Haustus Sodii Salicylatis* Co. of St. B. H. Ph. contains *Sp. Amm. Aromat.* This ensures alkalinity and tends to counteract the depressant action of the salicylate on the heart. The mixture gradually turns brown to black, but this does not injure its efficacy—the change of colour is due to oxidation, any alkali can produce it.

(2) *Spiritus Ætheris Nitrosi* is always given a prominent place among the incompatibles of Sodium Salicylate. It certainly changes the colour of the mixture to red or even black but otherwise it does no harm, so that the following is often prescribed as a febrifuge:—

R. Sodii Salicylatis	...	...	gr. xv.
Sp. Ætheris Nit.	...	...	℥ xxx.
Liq. Amm. Acet.	...	...	℥ ss.
Aq. Destill.	...	ad	℥ j.

If the *Sp. Ætheris Nit.* be distinctly acid (*see* Nitrites) it will of course precipitate Salicylic Acid.

- (3) *R.* Sodii Salicylatis gr. x.
 Quininæ Sulphatis gr. j.
 Aq. Chloroformi ʒj.

This is the *Haustus Sodii Salicylatis et Quininæ* of the *St. B. H. Ph.* The Salicylate of Quinine is insoluble in water and is therefore precipitated. The prescription should be dispensed with a "Shake the bottle" label, and it would be an improvement if a little mucilage were added to prevent the precipitate from adhering to the bottle.

(4) Sodium Salicylate can be prescribed with *Ferri et Ammonii Citras* or with *Ferrum Tartaratum*, but not with any ordinary ferric salt.

Example:—

- R.* Sodii Salicylatis gr. xv.
 Ferri et Am. Citratis gr. v.
 Glycerini ʒ xxx.
 Aq. Dest. ad ʒj.

This mixture may turn redder in colour, but there will be no precipitate.

Now for the *Ferri et Am. Cit.* substitute *Liq. Ferri Perchlor.*, ʒ x., or a similar dose of the tincture—a copious purple coloration or perhaps precipitate of basic ferric salicylate takes place. (Explanation).

(5) Sodium Salicylate should be prescribed with Caffeine itself, not with the Citrate of Caffeine.

- R.* Sodii Salicylatis gr. x.
 Caffeinæ Citratis gr. vj.
 Aq. Destill. ʒj.

The Citrate of Caffeine easily dissociates in water. The Citric Acid thus set free combines with the Sodium, and Salicylic Acid is precipitated within half an hour.

Now substitute for *Caffeinæ Citratis*, gr. vj., an equivalent amount of *Caffeine*, viz., gr. iij.—this will prove quite a stable mixture (*see* p. 12).

Salol is Phenyl-Salicylate—it is not decomposed by dilute acids, but alkalies split it up into Phenol and Salicylic acid. Therefore it should not be prescribed with alkalies. It is insoluble in water. It passes unchanged through the stomach and is split up in the alkaline secretion of the small intestine.

Salicin is soluble in water, 1 in 28 (*i.e.*, 1 oz. avoirdupois = 480 grs. in 28 fluid ozs. of water).

R. Salicin ...	...	...	...	gr. xx.
Tinct. Aurantii	...	...	...	℥ xx.
Aquam ...	...	...	ad	℥ j.

In this prescription some of the salicin would be undissolved because one ounce of water will dissolve at the most 17 grains.

Glycerin increases its solubility, therefore add to the prescription—*Glycerini*, ℥ xxx.

Bismuth salicylate is insoluble in water and as it tends to dissociate in water it is best given in cachets.

Strychnine.

Incompatible with the usual alkaloidal precipitants—*see* Alkaloids.

XX.

EXERCISES IN INCOMPATIBILITY.

The answers will be found in the next Chapter.

- (1) R. Ammonii Carbonatis ... gr. v.
Acid Syrupi Scillæ ... 3 j.
 Tincturæ Camphoræ Co. ... ℥ xxx.
 Aq. Destill. ... ad 3 j.
- (2) R. Hydrargyri Perchloridi ... gr. $\frac{1}{16}$.
 Potassii Iodidi ... gr. v.
pp - Liquoris Strychninæ Hyd. ℥ x.
 Aq. Destill. ... ad 3 j.
- (3) R. *+* Plumbi Acetatis ... gr. v.
 Aluminis ... gr. v.
 Aquæ Rosæ ... 3 j.
- (4) R. Quininæ Sulphatis ... gr. ij.
 Acidi Sulphurici Diluti ... ℥ iij.
+ Infusum Rhei ... ad 3 j.
- (5) R. Liq. Arsenii et Hydrarg. Iodidi ℥ x.
pp Quininæ Sulphatis ... gr. ij.
+ Acidi Sulphurici Diluti ... ℥ x.
 Aq. Destill. ... 3 j.

(6) R. Boracis gr. x.
ph. Zinci Sulphatis gr. ij.
 Aquæ Camphoræ ʒ j.

(7) R. Boracis *alk.* gr. x.
= Chloroform Chloral Hydratis gr. x.
 Aquæ Destill. ʒ j.

(8) R. Sodii Salicylatis gr. xv.
Salicylic acid. Syrupi Limonis ʒ j.
 Aq. Destill. ad ʒ j.

(9) R. Potassii Iodidi gr. v.
 Tinct. Ferri Perchlor. ʒ xv.
Huck's Sp. Ætheris Nitrosi ʒ xxx.
 Tinct. Gentianæ Co. ʒ xxx.
 Aquam Destill. ad ʒ j.

(10) R. Liq. Hydrargyri Perchloridi ʒ j.
 Potassii Iodidi gr. v.
 + Ammonii Carbonatis gr. v.
 Aq. Destill. ad ʒ j.

(11) R. Potassii Bromidi gr. xx.
 Tinct. Ferri Perchlor. ʒ x.
 Spiritus Chloroformi ʒ xv.
 Aq. Destill. ad ʒ j.

(12) R. Liquor Ferri Perchlor. ʒ x.
 Tinct. Guaiaci Ammon. ʒ xxx.
 Tinct. Aloes ʒ xx.
 Aq. Destill. ad ʒ j.

- (13) *R.* Liq. Arsenicalis ℥ v.
Tinct. Nucis Vom. ℥ x.
Infus. Cinchonæ Acidum ad ʒ j.
- (14) *R.* Liq. Plumbi Subacetatis ℥ xxx.
Mucilaginis Acaciæ ʒ j.
Aq. Destill. ad ʒ iv.
Fiat Lotio.
- (15) *R.* Liq. Hydrarg. Perchlor. ʒ j.
Sp. Ammon. Aromat. ℥ xxx.
Aq. Destill. ad ʒ j.
- (16) *R.* Quininæ Sulphatis gr. ij.
Sodii Salicylatis gr. xv.
Acidi Hydrobromici Diluti ℥ x.
Aq. Destill. ad ʒ j.
- (17) *R.* Liq. Arsenicalis ℥ v.
Syr. Ferri Iodidi ʒ j.
Aq. Destill. ad ʒ j.
- (18) *R.* Quininæ Sulphatis gr. ij.
Sodii Benzoatis gr. x.
Acidi Sulph. Dil. ℥ x.
Aq. Destill. ad ʒ j.
- (19) *R.* Sp. Amm. Aromat. ℥ xxx.
Liquoris Calcis ʒ ss.
- (20) *R.* Bismuthi Subnitratis gr. x.
Tinct. Opii ℥ xv.
Sp. Ammon. Aromat. ℥ xxx.
Aq. Destill. ad ʒ j.

- (21) R. Plumbi Acetatis ... gr. x.
 Boracis ... gr. x.
 Aquæ ... 3 j.
 Fiat Lotio.
- (22) R. Diuretin ... gr. v.
 Sp. Ætheris Nitrosi ... ℥ xxx.
 Liq. Ferri Perchlor. ... ℥ xv.
 Aquam Destill. ... ad 3 j.
- (23) R. Syr. Ferri Iodidi ... 3 j.
 Pot. Iodidi ... gr. v.
 Pot. Bicarb. ... gr. xv.
 Aquam ... ad 3 j.
- (24) R. Caffeinæ Citratis ... gr. v.
 Sp. Amm. Aromat. ... ℥ xxx.
 Aq. Destill. ... ad 3 j.
- (25) R. Morphinæ Sulphatis ... gr. $\frac{1}{2}$.
 Tinct. Catechu ... 3 j.
 Syr. Aromatici ... 3 j.
 Aq. Destill. ... 3 j.
- (26) R. Bismuthi Subnitratis ... gr. x.
 Tinct. Opii ... ℥ x.
 Misturam Cretæ ... ad 3 j.
- (27) R. Sp. Ætheris Nitrosi ... 3 j.
 Liq. Amm. Acetatis ... 3 ss.
 Aq. Destill. ... ad 3 j.

(28) R̄. Sodii Salicylatis ... gr. xx.
 Potassii Bicarb. ... gr. xx.
 Tinct. Quininæ Ammoniatæ ʒ j.
 Syrupi Aurantii ... ʒ j.
 Aq. Destill. ... ad ʒ j.

(29) R̄. Ferri et Quininæ Citratis gr. x.
 Potassii Citratis ... gr. xl.
 Syrupi Aurantii ... ʒ j.
 Aquam Destill. ... ad ʒ j.

(30) R̄. Magnesii Carbonatis ... gr. x.
 Magnesii Sulphatis ... ʒ j.
 Glycerini ... ʒ ss.
 Infusum Rosæ Acidum ad ʒ j.

(31) R̄. Tincturæ Ferri Perchloridi ʒ x.
 Acidi Phosph. Diluti ... ʒ x.
 Tincturæ Nucis Vomicæ ... ʒ x.
 Sp. Chloroformi ... ʒ xxx.
 Aq. Destill. ... ad ʒ j.

(32) R̄. Ferri et Am. Cit. ... gr. v.
 Acidi Nitrohydrochlor. Dil. ʒ x.
 Aq. Menth. Pip. ... ad ʒ j.

XXI.

ANSWERS TO EXERCISES.

1. The syrup of squills is made from the *Acetum Scillæ*. It contains acetic acid and causes effervescence with the ammonium carbonate.

2. Solutions of the two first substances will react to form mercuric iodide, soluble in solution of potassium iodide.

The potassium mercuric iodide (Mayer's reagent for alkaloids) thus formed, will precipitate the alkaloid from the *Liq. Strych. Hyd.*

3. Alum is a sulphate, therefore insoluble lead sulphate is formed.

4. The tannin contained in the infusion will throw down insoluble tannate of quinine.

5. Double iodides precipitate alkaloids. Moreover, the presence of free acid will liberate iodine.

6. Borax is biborate of sodium—insoluble borate of zinc will be precipitated.

7. Borax is alkaline, and will, therefore, presently decompose the chloral hydrate with evolution of chloroform.

8. The syrup of lemons contains much free citric acid.

This citric acid will turn out the salicylic acid, which being insoluble will be precipitated.

9. The ferric salt will release iodine, and so will the *Sp. Ætheris Nitrosi* if it be acid. The iron will react with the tannin of the *Tinct. Gent. Co.* to form an inky precipitate.

10. If the ammonium carbonate be added first to the Liq. Hyd. Perch. it will, of course, precipitate the ammoniated mercury. But if the two first ingredients be mixed to begin with, potassium mercuric iodide will be formed, and then the ammonium carbonate may be added without any precipitation taking place.

11. If the bromide and the tincture be mixed without previous dilution—bromine will be set free. But if each be diluted with half the vehicle before mixing, probably no reaction will take place, but the combination is an uncomfortable one.

Bromides react like iodides but are much less sensitive. For the reaction between iodides and ferric salts *see* Iodides.

12. The ammoniated tincture of guaiac will give a blue colour with the Tinct. Ferri Perchlor., or a black if the former has been kept a long time.

And the Tinct. Ferri Perchlor. will give a brown-black colour with the aloes. If the ammoniated tincture be sufficient to make the mixture alkaline, ferric hydrate will be precipitated.

The guaiac resin will be precipitated, and so will be some of the constituents of the tincture of aloes.

13. In the proportions given this mixture is not incompatible, if the two first ingredients be mixed without dilution the alkaline liquor may throw down the alkaloids, but this will not happen if they have been previously diluted with the vehicle, especially as the latter contains sulphuric acid which forms with the alkaloids salts soluble in water.

14. The subacetate of lead will precipitate the mucilage.

Acetate of lead does not coagulate mucilage of acacia.

15. Hydrargyrum Ammoniatum (white precipitate)

will be thrown down. The essential oils of the Spiritus will separate out on the addition of the water.

16. Salicylate of quinine, being almost insoluble in water, will be thrown down, and the dilute hydrobromic acid will combine with the sodium and precipitate salicylic acid.

17. The alkaline Liq. Arsenicalis will precipitate the iron.

(18) Sodium benzoate and dilute sulphuric acid will form sodium sulphate and benzoic acid. Benzoic acid being insoluble in water will be precipitated.

Sodium benzoate and the bisulphate of quinine (=the sulphate of quinine dissolved in dilute sulphuric acid) will form benzoate of quinine.

Benzoate of quinine being insoluble in water will be precipitated.

(19) Calcium carbonate will be precipitated.

(20) Spiritus Amm. Aromat. will react slowly with the Bismuth Subnitrate (which of course is undissolved) to form an oxycarbonate of bismuth and CO_2 will be given off.

(21) Lead borate will be precipitated.

(22) Diuretin is sodium theobromine salicylate. It is decomposed by acids—Sp. *Ætheris Nitrosi* may be acid and the Liquor Ferri Perchlor. is of course acid. Therefore the theobromine will be precipitated. The first effect is a deep violet colour due to ferric salicylate.

The Sp. *Ætheris Nitrosi* also may effect its colour change on the salicylate.

(23) The alkali will precipitate the hydrate of iron.

(24) This is not incompatible because, caffeine being fairly soluble in water and more soluble in dilute alcohol, its salt will not be precipitated on adding an alkali.

Citrate of caffeine being as a rule acid, there may be

some effervescence. The essential oils of the Spiritus will of course separate when it is mixed with the water.

(25) Tannate of morphine is precipitated.

(26) The calcium carbonate will slowly decompose the subnitrate of bismuth.

(27) If the Sp. *Ætheris Nitrosi* be old and strongly acid, it will react with the acetate to the decomposition of both, with evolution of mixed gases, carbon monoxide, carbon dioxide, &c. (Scoville). If the Sp. *Æth. Nit.* be in good condition the mixture is not incompatible, on the contrary it is a very usual and successful combination (*see Nitrites*).

(28) The ammoniated tincture will precipitate hydrate of quinine on the addition of the vehicle.

And salicylate of quinine will also be thrown down.

(29) Some salts, of which potassium citrate is one, neutralize the solvent action of ammonium citrate on quinine citrate. Therefore in this prescription, even though the citrate of potash be neutral, citrate of quinine soon separates out, and being sparingly soluble in water it is precipitated—nor is this prevented, except temporarily, on making the mixture distinctly acid, by the addition of a few grains of citric acid (*see Quinine*, p. 97).

If the citrate of potash be alkaline the hydrate of quinine is at once thrown down.

(30) The mixture is alkaline, therefore the acid infusion will change colour—the mixture will become blue and then brown (*see p. 46*).

There will be effervescence between the carbonate and the acid infusion.

The magnesium carbonate being an insoluble salt will of course not be in solution.

(31) Phosphate of iron will be formed, but it will not be precipitated because it is soluble in the excess of

phosphoric acid and of the free acid of the Tinct. Ferri Perchlor.

Therefore this prescription is not really incompatible. *See* Haust. Ferri c̄ Nux Vomica (St. B. H. Ph.).

(32) The acid decomposes the ammonium citrate and the much less soluble ferric citrate is precipitated. Nor can Ferrum Tartaratum be prescribed with mineral acids.

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